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HAROLD L. ICKES, Secretary

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R. R. SAYERS, Director

MINERALS YEARBOOK

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FOREWORD

Minerals Yearbook, 1944, records another year of outstanding accomplishment by the mineral industries of the United States. For the sixth consecutive year the quantity of minerals produced has increased, and in each of the last 5 years the physical volume of production has exceeded all previous records. In 1944, for the third consecutive year, the value of production also reached a new peak. As in previous war years, this performance was made despite many difficult conditions that imposed serious restraints on production. The record of the successful prosecution of the war on the industrial front will accord high credit to the contributions of the owners, workers, and managers who have made this performance possible.

As predicted a year ago, 1943 proved to be the year in which the summit of industrial effort in this war was reached, but contrary to expectations it was not the year of maximum production and consumption for minerals. Owing to the heavy demand for fuels and a few other minerals, which moved contrary to the general trend of industrial production, the over-all trend of consumption as well as production was upward, although there were fewer increases and new records for individual commodities and considerably more decreases than in previous years. The construction phase of the war program reached a peak in 1942, and the precipitous decline noted in 1943 continued in 1944. The production of the implements of war in preparation for great offensives probably reached a peak early in 1944 although the tremendous need for replacements in the Pacific warfare and following the invasion of Europe in June 1944 maintained production at high levels. Sharp declines in war production in 1945 will be offset only in part by increasing civilian production. Industrial indexes for the first half of 1945 indicate that the total year's activity will be under that of 1944.

Victory in Europe, signalized by the surrender of the Germans at Rheims, France, on May 7, 1945, brought into sharper focus the various postwar mineral problems mentioned in the Foreword of Minerals Yearbook, 1943. No permanent solution to the difficulty presented by surplus stocks that will remain in the possession of the Government at the end of the war had been made as of July 1945. Late in 1944 Congress provided for temporary freezing of stocks of strategic and critical minerals in the Surplus Property Act approved in October, but this action expires in January 1946. Permanent stock-piling legislation has been introduced into Congress that will provide for transfer of most surpluses to permanent stock piles.

The long-range future of mineral supplies to support our vast industrial structure and high standard of living will soon command our attention instead of the shorter-term war objectives that have occupied our entire effort since 1940. The United States is by no means a "have-not" nation in minerals, but there is unmistakable

evidence that some of our commercial resources are approaching exhaustion and in others depletion is well advanced. Recognizing this situation, the Bureau of Mines is planning conversion of its wartime services to peacetime activities oriented to the broader objectives. Fortunately no drastic readjustments are required because in general the program developed during the war does not differ greatly from the Bureau's traditional peacetime activity. National defense will continue to receive serious consideration in Bureau plans. Some shift in emphasis will be required as the program is broadened to cover all industrial minerals in contrast to the very heavy emphasis on strategic and critical minerals during the war. Moreover, the program will become more national in scope as less effort will be required on purely local and temporary war problems. The Bureau's well-established services to industry will of course continue unabated and will be expanded wherever such action is advisable.

Exploration and technologic research on a broad scale are primary requirements if we are to utilize our domestic resources most effectively. To plan wisely industry must first know what we have. A reliable inventory of mineral resources is thus most essential. Efforts to achieve more efficient processing and lower costs as we are forced to operate with lower-grade materials also must be intensified. As resources play out, we should have others ready to replace them. Promotion of health and safety in the mineral industry has always been a major objective of the Bureau of Mines, and its program in this field will continue virtually without change. Similarly the Bureau's program in economics and statistics is scarcely different in war than in peace. Vast improvement has been made in the statistical program to meet war needs, and this gain fills many serious gaps that existed before the war. The Bureau plans to retain and add to these war improvements; in addition, recognizing the greater need for imported mineral raw materials and foreign markets for those minerals produced in excess of domestic needs, the Bureau's facilities for obtaining foreign statistical and other economic data will be expanded. The Bureau thus looks forward eagerly to being of more service to industry and the public and to the presentation of even more useful editions of Minerals Yearbook in the future.

The cordial cooperation of State agencies and officials is an important contribution to the Bureau's statistical program, and it is a pleasure again to acknowledge this assistance with deep appreciation. This teamwork between Federal and State agencies dates back to 1908, and many of the States have taken advantage of the cooperative agreements offered by the Bureau of Mines. By this device much economy is effected, producers and consumers of minerals are relieved of the burden of answering two sets of inquiries, and the State officials are given the detailed information supplied to the Bureau of Mines by respondents in their States. State agents cooperating in the 1944 canvass were: Walter B. Jones, State geologist, University, Ala.; Herman Gunter, State geologist, Tallahassee, Fla.; Garland Peyton, director, division of mines, mining, and geology, department of natural resources, Atlanta, Ga.; M. M. Leighton, chief, and Walter H. Voskuil, mineral economist, State geological survey division, Urbana, Ill.; A. C. Trowbridge, director, Iowa Geological Survey, Iowa City, Iowa; John C. Frye, acting director, State Geological

Survey of Kansas, Lawrence, Kans.; J. T. Singewald, Jr., director, department of geology, mines and water resources, board of natural resources, Baltimore, Md.; R. A. Smith, State geologist, Lansing, Mich.; Edward L. Clark, State geologist, Rolla, Mo.; Edward Ellingwood, chairman, New Hampshire mineral resources committee, Concord, N. H.; Meredith E. Johnson, State geologist, Trenton, N. J.; John G. Broughton, assistant State geologist, New York State Museum, Albany, N. Y.; Jasper L. Stuckey, State geologist, Raleigh, N. C.; Robert H. Dott, director, Oklahoma Geological Survey, Norman, Okla.; E. P. Rothrock, State geologist, Vermillion, S. Dak.; E. H. Sellards, director, bureau of economic geology, Austin, Tex.; Arthur Bevan, State geologist, and Linwood H. Warwick, chief clerk, Virginia Geological Survey, Charlottesville, Va.; Sheldon L. Glover, supervisor, division of mines and mining, department of conservation and development, Olympia, Wash.; R. C. Tucker, assistant State geologist, Morgantown, W. Va.; and E. F. Bean, State geologist, Madison, Wis. In addition, B. D. Stewart, department of mines, Juneau, Alaska, and Walter W. Bradley, State mineralogist, San Francisco, Calif., assisted in the compilation of statistics for Alaska and California, respectively.

The Bureau of Mines is no less appreciative of the wholehearted cooperation extended by thousands of individuals and organizations in the mineral industry, trade journals, and other Government agencies, whose generous help has made possible the preparation of this volume.

R. R. SAYERS,
Director.

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INTRODUCTION

In view of the termination of the war, Minerals Yearbook, after 3 years as a confidential volume, returns to its prewar status with the 1944 edition.

Publication of foreign-trade data and data on many strategic and critical minerals, first interrupted in the 1941 volume, was reestablished for most commodities on VE-day; and upon the formal announcement of VJ-day all remaining censorship regulations were removed, thus restoring and bringing up to date all statistical series regularly carried in Minerals Yearbook and releasing again the entire volume for public distribution.

Because of Government wartime restrictions on the publication of statistics in many countries, few figures on foreign mineral production have been available since 1939. However, with the liberation of the countries in the war zone and the easing of security regulations in many others, much data covering this 5-year period have been obtained from abroad and are included in the present volume under the respective commodity chapters.

The 1944 volume departs from the 1943 edition in but one main respect—the chapter on International Aspects of War Mineral Procurement has been greatly expanded to include a section on Foreign Minerals Review, emphasizing in particular Latin-American countries. The new section constitutes part V of the volume and will be a permanent feature of future editions.

Acknowledgments.—The Bureau deeply appreciates the warm support of the many individual mine and plant operators, distributors, consumers, public officials and agencies, trade associations, and others who have freely supplied the basic information to compile this volume.

The data on exports and imports in Minerals Yearbook were obtained through cooperation of the United States Department of Commerce.

Credit is gratefully accorded to the authors of the chapters and to many others of the Bureau's staff for their assistance and splendid cooperation in compiling, editing, and preparing the Yearbook material. Those deserving especial mention in this work are: Martha B. Clark and Marian E. Meyer, of the Economics and Statistics Branch, for preparing the statistical summary of mineral production and assuming the responsibility for the continuity of data and the uniformity of statistical presentation; Mabel E. Winslow, of the Office of Minerals Reports, for editorial supervision and constant counsel; Louis F. Perry, of the Office of Minerals Reports, and Adelaide B. Palmer, of the Economics and Statistics Branch, for the preparation of charts; and the many other members of the Economics and Statistics Branch for their assistance in the preparation of the manuscript.

C. E. NEEDHAM.

PART I. GENERAL SUMMARY

REVIEW OF THE MINERAL INDUSTRIES IN 1944¹

By E. W. PERRSON

SUMMARY OUTLINE

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INTRODUCTION

The value of mineral production in the United States established a new peak in 1944 for the third consecutive year. The total value—\$8,452,000,000—was 4.7 percent above the previous peak of 1943 and 52.5 percent higher than the World War I total of \$5,540,708,000 recorded in 1918; it was 21.1 percent over the prewar high of \$6,981,340,000 established in 1920. The new record resulted from a 6.1-percent rise in the physical volume of production, as measured by Federal Reserve Board indexes, accompanied by a 2.9-percent increase in the unit sales realizations of mineral producers.

Again it is necessary to record that this unprecedented performance of the mineral industries was accomplished despite many conditions that imposed severe restraints on production. Manpower continued to be the principal bottleneck, the total labor force in the mineral industries having declined 9 percent from the already depleted supply available in 1943. By working more days and longer hours the loss in man-hours of labor was reduced to 2 percent. Lack of price incentive also was an important factor. Since 1940 mineral prices have increased only 23.2 percent, including premiums, whereas the price level of all commodities has advanced 32.3 percent and that of farm products 82.1 percent. The depleted state of our mineral reserves also prevented increases in production of some commodities. This situation is caused partly by the terrific drain on the Nation's resources that has taken place during the past 60 years and partly by the lack of development, which could not be financed during the prolonged unprofitable depression period and for which labor and equipment have not been available during the hectic war period. Other restraining factors in 1944 included transportation controls, shortages

¹ In this report the term "billion" is equivalent to 1,000,000,000.

of equipment, increasing costs, and the shut-down orders for gold and silver mines.

There was much evidence in 1944 that the Nation's war program had reached a peak on the industrial front. The Federal Reserve Board monthly index of industrial production indicates that the peak actually was reached in the latter part of 1943. The Board mineral-production index reached a high late in 1944. Consumption of many mineral commodities, particularly building materials and metals, was lower in 1944 than in 1943, but new records were made in some important fuels, in a few important metals, and in the fertilizer minerals, so that on the whole probably there was a slight net gain in consumption. Production of many minerals also declined in 1944, but these losses were more than offset by gains in the output of several important commodities. There was considerable relaxation of inventory and use controls during the year, but some of this action proved to be premature and had to be rescinded following the temporary reverses on the European front late in the year. Imports continued at a high rate, and, although Government stock-pile objectives were reduced during the year, Government inventories of many minerals increased. These gains were offset only in part by many declines in industry stocks, so that the total mineral inventory of the country increased in 1944.

Price movements, as measured by producers' unit realizations on sales, were upward, the more important gains being in fuels and other nonmetallics. An estimated 2.9-percent increase in producers' price realizations in 1944 over 1943 compared favorably with the 0.9-percent increase in the general price level as revealed by the Bureau of Labor Statistics indexes of wholesale prices. The war-inflated price of mercury was one of the first mineral prices to undergo drastic reduction as a result of an easier supply situation.

PRODUCTION

Value of mineral output.—The record established in 1944 resulted from increases in the production of mineral fuels, as the total output of metals and other nonmetallic products declined. Fuels, which comprised 61.7 percent of the total value of mineral production or \$5,212,000,000 in 1944, increased 13 percent in value in 1944 over 1943, whereas metals and other nonmetallics declined 6 and 8 percent, respectively. Metals comprised 27.7 percent of the total in 1944 and other nonmetallics 10.6 percent. The growth in value of these branches of the mineral industries since 1880 is shown in figure 1.

Contrary to the situation prevailing in recent years, the rise in the value of mineral production in 1944 compared favorably with advances in other parts of the economy. The 5-percent gain in mineral value exceeded the 3-percent increase in gross farm income as reported by the United States Department of Agriculture (\$22,775,000,000 in 1943 and \$23,446,000,000 in 1944, including Government payments). It was slightly below the 6-percent increase in gross national product from \$187,800,000,000 in 1943 to \$198,700,000,000 in 1944; war expenditures comprised 43 percent of the gross national product in 1944 and 44 percent in 1943. National income rose nearly 8 percent from \$149,400,000,000 to \$160,700,000,000, according to the United States Department

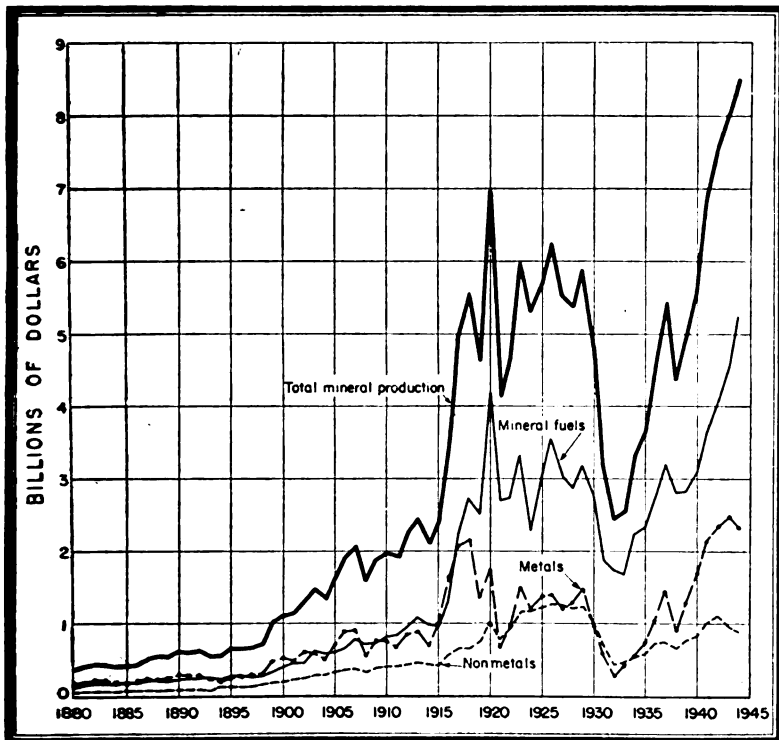


FIGURE 1.—Trends in value of mineral production in the United States, 1880–1944.

of Commerce. However, compared with 1939 the value of mineral production in 1944 had increased only 72 percent whereas gross farm income had advanced 137 percent, gross national product 124 percent, and national income 127 percent.

Failure of the mineral industry to pace other elements of the national economy may be ascribed to several factors. Some mineral commodities, such as gold, silver, and certain building materials, have been adversely affected by war conditions, so that their production has not profited from the general economic improvement. Government controls have restrained civilian and in many instances military consumption of most of the other minerals, and these restraints have been reflected in mining activity. Shortage of manpower, exhaustion or lack of resources, inadequate production capacity, and scarcity of mining equipment have prevented the domestic industry from meeting all war needs of some minerals, and the deficiencies have been made up by abnormally large importations. Copper, lead, and zinc are typical examples of this development. All these factors have retarded the advance in mineral production; and in addition, as will be shown later, the rise in the value of mineral production has been impeded by prices that consistently have been substantially below the general level.

Trends in physical volume of production.—Figure 2 compares the physical volume of mineral production during the last 45 years with industrial and agricultural production and with population growth,

each expressed in terms of an index based upon yearly averages for 1935-39.³

The long-time trends of production during this 45-year period have been steadily upward, although year-to-year and cyclical fluctuations have been prominent. Except for the last few years, the production of minerals—the essential raw materials for industry—has been closely correlated with the trend of industrial production, experiencing the

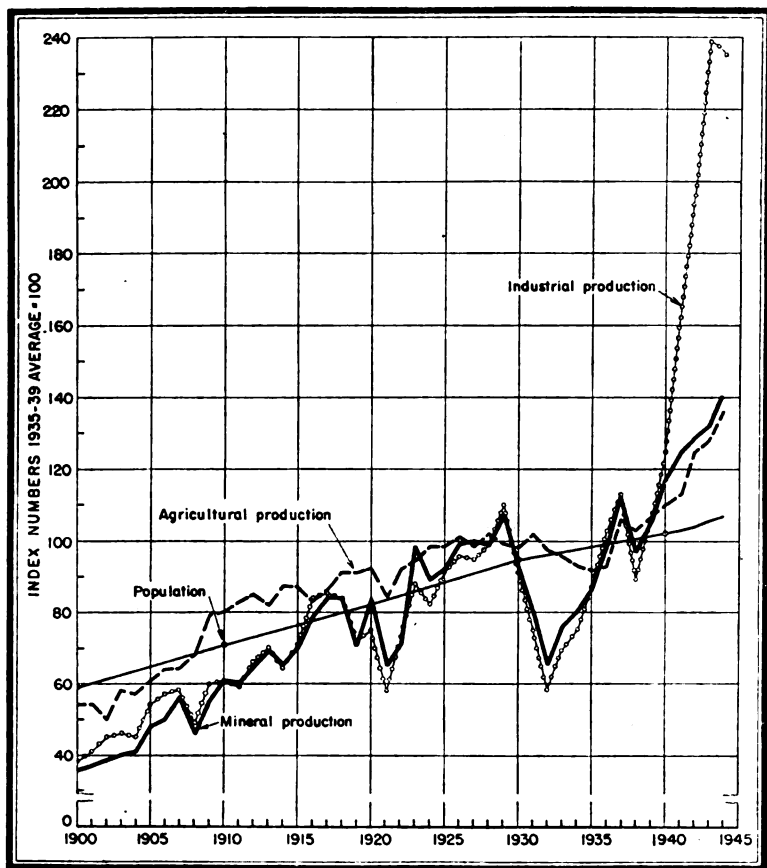


FIGURE 2.—Comparison of growth of physical volume of mineral production with that of agriculture and industrial production and population, 1900-1944.

same ups and downs, whereas agricultural production has exhibited more moderate fluctuations and a growth line approximating the trend of population increase.

Because production of coal for domestic use and of petroleum for automobile fuel (which has a pronounced effect on the trend of mineral output) does not respond proportionately to increases in the rate of manufacturing activity and is more stable, the index of industrial

³ The following indexes have been used: Volume of farm production, U. S. Department of Agriculture; mineral production, 1900-1918, Warren Persons' Forecasting Business Cycles; mineral production of 1919-44 and industrial production, Federal Reserve Board; total population of the United States, Bureau of the Census.

production tends to exceed that of mineral production in periods of prosperity and to fall below during depressions. This characteristic explains in part the wide gaps between the two indexes from 1941 to 1944. Another contributing factor is the extensive use of imported mineral raw materials in these years, which is reflected in the industrial but not in the mineral index. It should also be noted that the Federal Reserve Board index of mineral production does not include certain mineral products, such as aluminum and magnesium, while the greatly expanded war production of aircraft in which these metals are used is included in the index of industrial production.

Although the total mineral output scored a new peak in 1944, there were fewer individual commodity records than in 1943 and 1942. As in 1943, the advances in fuels weighed heavily in the total result. Production of crude petroleum increased 11 percent, natural gasoline and liquefied petroleum gases 14 percent, natural gas 11 percent, bituminous coal 5 percent, and anthracite 5 percent; all except anthracite reached new heights in 1944. The declining tempo of war production is reflected in the record of domestic metal production during the year. Among the common metals produced in quantity in the United States, manganese ore, titanium minerals, arsenic, and cadmium registered increases, and all these reached new peaks. Copper, lead, and zinc production fell 11, 8, and 3 percent, respectively, compared with 1943; manpower shortages accounted for much of these declines. Iron-ore production dropped 7 percent, and there were large decreases in the outputs of chromite, molybdenum, vanadium, and tungsten. Considerably less aluminum and magnesium was produced in 1944 than in 1943. The precious metals again fared badly; gold production decreased 27 percent and was the lowest on record since gold was discovered in California in 1848; the output of silver was 17 percent lower than in 1943. Among the more important nonmetallic mineral products barite, mica (scrap-grade), phosphate rock, potash, salt, lithium minerals, and mineral wool advanced to new highs. Production of asbestos, feldspar, slate, and sulfur advanced over 1943 but did not reach previous peaks. Production of cement, clays, gypsum, sand and gravel, stone, and other important nonmetallic commodities declined.

STOCKS

Inventory trends in 1944 presented decidedly mixed patterns, but the predominant change was upward. In those commodities of which the Government was a substantial buyer there was a notable tendency for industry stocks to decline, with gains in Government inventories more than offsetting the decline. This was true of aluminum, chromite, copper, metallurgical-grade fluorspar, Ceylon graphite, manganese ore, mercury, muscovite mica, platinum, quartz crystals, tungsten, and zinc. Industry stocks of bauxite declined, and those of Government increased, but there was a net decrease in the total. Increases in both industry and Government stocks were noted among the more important minerals only for magnesium and nickel. Decreases in both industry and Government holdings were more prevalent, such changes having been recorded for antimony, asbestos, cadmium, cobalt, synthetic and natural cryolite, acid-grade fluorspar, lead, and tin. Although Government stocks of tin concentrates increased slightly in 1944, it was evident that the United States tin position was rapidly

approaching dangerously low levels. Industry stocks of cement, iron ore, and sulfur were smaller at the end of the year than at the beginning, whereas those of anthracite, bituminous coal, ilmenite, molybdenum, and potash were larger; Government stocks of these commodities were either nil or very small. Stocks of crude petroleum were considerably lower at the end of the year than at the beginning, but this drop was partly offset by a substantial gain in refined stocks so that the net decline was relatively small.

The relaxing of inventory control measures noted in the latter part of 1943 continued in 1944, and as the war situation improved and shipping became less hazardous the War Production Board reduced its stock-pile objectives. Expectation of early termination of the war caused concern over the status of Government stocks when hostilities would cease. To prevent surplus materials from being dumped on postwar markets Congress included a temporary stock-freezing provision for strategic and critical materials in the Surplus Property Act, which it passed the latter part of 1944. These developments are discussed under the section of this chapter entitled Government Stock-Piling Activities.

CONSUMPTION

Evidence of the fact that the United States had reached its peak strength on the industrial front for this war is afforded by the record of mineral consumption in 1944. There were more decreases than increases in the use of individual commodities as compared with 1943; but because increases were recorded for most of the fuels, which comprise such an important part of the mineral total, there probably was a slight gain in total mineral consumption. The use of fertilizer minerals increased to new records in 1944, but that of metals was generally downward, the decline in ferro-alloying ores and light metals being substantial. Consumption of building materials and several of the strategic nonmetals also declined in 1944.

The Federal Reserve Board index of industrial production declined from 239 in 1943 to 235 in 1944 (1935-39 average=100) to which levels it had advanced from 89 in 1938 and 109 in 1939. The monthly record shows that the peak war production was attained in October and November 1943, when the adjusted index stood at 247; from January to December 1944 the monthly index declined from 243 to 232. The durable manufacturers index, which was 78 in 1938 and 109 in 1939, rose to 360 in 1943 and then declined to 353 in 1944. The production index for transportation equipment, including airplanes, automobiles, ships, railroad cars, and locomotives, rose from less than 100 early in 1939 to a peak of 786 in November 1943 and stood at 709 in December 1944. The heavy munitions phase of the war-production program definitely had reached its peak in 1943.

The apparent over-all increase in mineral consumption in 1944 over 1943 in the face of the 2-percent drop in industrial production may be explained by the tremendous demand for fuels and ammunition to meet the increasing activity on the fighting fronts. This would tend to increase the consumption of minerals to an extent that might more than offset the decline resulting from the tapering off in plant construction and the building of heavy war equipment which loom large in industrial production.

The more important minerals that achieved new records in consumption in 1944 included petroleum, natural gasoline, natural gas, phosphate rock, potash, nitrogen (probable), barite, sulfur, salt, lead, zinc, and manganese ore. The use of anthracite, feldspar, slate, copper, tin, and antimony was higher in 1944 than in 1943 but failed to reach new highs. Consumption of iron ore and tungsten each declined only 1 percent in 1944, but decreases in the use of many other metallic ores and metals, including chromite, molybdenum, vanadium, aluminum, bauxite, magnesium, mercury, nickel, and platinum, were considerably greater, ranging from 5 to 30 percent. Steel production increased slightly to a new peak; as a result, consumption of iron ore and manganese ore was maintained at high levels, but the 19-percent decline in the production of alloy steels was reflected in a sharp falling off in the use of other major ferro-alloying minerals. Despite the record output, there was a slight decrease in the domestic consumption of bituminous coal as a result of increased demand for bunker and export fuel and continued rationing at home.

Building activity continued the sharp decline noted in 1943 following the completion of a large part of the industrial plant expansion and military cantonment construction programs. According to the United States Department of Commerce, the total value of all new construction put in place in continental United States during the year was \$3,935,000,000, a 49-percent decline from \$7,675,000,000 in 1943 and a 77-percent drop from the peak of \$17,379,000,000 in 1942; the value in 1938 was \$5,254,000,000. The major declines in 1944 were in military, naval, and public industrial construction. Highway and public and private residential building also declined, but signs of re-conversion were noted in the increase in privately financed industrial, farm, and public utility construction. As a consequence of these reductions, consumption of building materials of mineral origin, including cement, clays, sand and gravel, and stone, were considerably lower in 1944 than in previous recent years. The consumption of lime declined only slightly, that of gypsum was virtually the same as in 1943, and that of slate increased slightly.

PRICES

Average mineral prices in 1944 advanced more than the general price level. An index of producers' unit realizations on 24 minerals that represent over 96 percent of the value of mineral production, weighted according to 1940 production, showed an average increase of 2.9 percent over 1943. Bureau of Labor Statistics indexes of wholesale prices for all commodities and for farm products each increased less than 1 percent. However, during the entire war period prices for minerals have advanced much less than those of other commodities. Since 1940 unit price realizations for minerals have increased only 23.2 percent, whereas prices for all commodities have risen 32.3 percent and those of farm products 82.1 percent. These computations for minerals include premium prices paid for copper, lead, and zinc but do not include the transportation subsidies paid by the Government on other commodities.

Fuels prices have fared better than other mineral prices during the war. Since 1940 the weighted average price realization by producers of 5 mineral fuels has increased 27.5 percent; 1944 averages were 4

percent over those in 1943. Average prices for 10 metals rose 18.3 percent from 1940 to 1944 but only 1 percent from 1943 to 1944. The index of prices for 9 nonmetallic minerals other than fuels advanced 14.4 percent from 1940 to 1944 and 2.1 percent from 1943 to 1944.

There were few changes in ceiling prices in 1944. Of particular significance were those for coal granted as a result of wage increases. Prices for most metals were virtually unchanged in 1944. Ceilings for copper, lead, and zinc were maintained at 1943 levels, but a larger proportion of the domestic production came under premium prices, so that the average prices realized by producers were substantially higher. The average value of petroleum at the well was only slightly higher in 1944 than in 1943, but there was an appreciable rise in the estimated value of natural gas and natural gasoline at producing centers. With the exception of sand and gravel and natural and petroleum asphalts, prices of which were lower, producers of nonmetallics received slightly higher or the same unit returns in 1944 as in 1943. The outstanding decline in 1944 was in the price of mercury, which followed a sharp drop in demand and the entrance of European mercury in the domestic market in quantity for the first time since 1941. Producers of tungsten also received less for their product in 1944 than in 1943.

The Bureau of Labor Statistics index (1926=100) of wholesale prices for all commodities rose from 78.6 in 1940 to 103.1 in 1943 and 104.0 in 1944. The index for farm products was 67.7 in 1940, 122.6 in 1943, and 123.3 in 1944 and showed the greatest rise during the war period of any major group of commodities. The fuel and lighting index increased from 71.7 in 1940 to 80.8 in 1943 and 83.0 in 1944; the index for anthracite rose from 90.4 in 1943 to 95.6 in 1944, that for bituminous coal from 116.1 to 120.3, coke from 122.7 to 130.3, and petroleum and products from 62.5 to 63.9. The metals and metal products index was 103.8 in 1944 and 1943 compared with 95.8 in 1940; fabricated products weigh heavily in the computation of indexes for this group. In the building materials field, for which the group index showed a better than average rise in 1944—115.5 compared with 111.4 in 1943 and 94.8 in 1940—gains over 1943 were noted for brick and tile, and cement. The price index for fertilizer materials was 81.3 in 1944, 80.0 in 1943, and 69.4 in 1940.

EMPLOYMENT

In 1944 approximately 11,000,000 men were in the armed forces, and with heavy production schedules to be met by American industry acute labor shortages were the order of the day. Even in those mining and refining industries in which production requirements declined, operators had difficulty in hiring and holding enough manpower to meet the demand. The total labor force in the mineral industries has dropped steadily from 835,183 men in 1941 to 763,320 in 1943 and 693,800 in 1944. Reduction in the number of employees has been compensated to some extent by working the available men more and longer days. Workdays per employee increased from an average of 279 in 1943 to 285 in 1944 and hours from 2,104 to 2,264. Total man-days were 7 percent lower than in 1943, but total man-hours declined only 2 percent.

Selective Service continued to take many of the younger men. In order to maintain high output of minerals, a policy favoring the deferment of miners was in force at the beginning of the year, but when the

need for combat replacements increased, a more stringent policy was adopted. Deferments of men under 30, particularly those under 26, were reviewed, and many were taken. In response to protests from employers, a new list of "supercritical" activities was drawn up by an Inter-Agency Committee and used by Selective Service as a guide in granting deferments to men under 26. At that time the agencies represented considered that supplies of metals and minerals were adequate, and further deferment preference was not warranted. However, on the recommendation of the War Manpower Commission, coal miners under 26 were deferred, owing to the serious threat of a severe coal shortage. Fortunately the Army and Navy had reached approximately their enlistment goals so total monthly quotas were comparatively low and the heavy withdrawals from the age groups under 26 were compensated by fewer inductions above that age. Under these conditions withdrawals from the mineral industries were serious but not as severe as had been anticipated.

Inductions into the services have increased the average age of workers substantially. In 1944 the War Manpower Commission reported that in the past 2 years the average age of coal miners had increased from 32 to over 40.

Responsibility for labor distribution was vested in the War Manpower Commission. In the mineral industries, it had the greatest difficulty in maintaining an adequate labor force in the coal industry. During most of the year the shortage was estimated to be between 30,000 and 40,000 men. Recruiting campaigns, training programs, assistance with deferments, interchange of information on efficient manpower utilization, and preferential reference of available men were among the methods used to supply men to essential operations. On July 1, 1944, the War Manpower Commission established a Nation-wide system of labor priority referrals, which provided that employers should hire male workers only from those referred by the United States Employment Service. Under this plan each plant was given a priority rating and USES channeled workers into essential and locally needed activities in the order of their relation to the war program.

Congress seriously considered several bills, some of which were actively supported by the War and Navy Departments, that would have established various forms of national labor service, particularly for men of draft age who had been rejected for military service. This movement met strong opposition from labor and other groups and was finally abandoned.

Although relatively few in number compared with the men taken by Selective Service, some veterans were released from military service and returned to their old or to new jobs. As their total became appreciable and the prospect of much greater numbers loomed in the future, Selective Service outlined the methods by which local draft boards are to assist the return of veterans to civil life. Local boards are responsible for protection of the reemployment rights of veterans and also will assist them in obtaining other positions through the USES if they do not wish to return to previous employers.

As victories on the battlefields indicated that the war was approaching conclusion, Congress turned its attention to reconversion. The prospect of temporary or prolonged unemployment ranks high among

the critical problems anticipated. After debating the merits of Federal versus State supervision of unemployment compensation Congress passed the George bill establishing the Office of War Mobilization and Reconversion that is to have general powers over the reconversion program. This law provides that unemployment compensation is to be administered by the States according to their individual rules, but a Federal fund is made available for interest-free loans to the States to insure the solvency of their unemployment funds.

With the gradual increase in the cost of living, the pressure for compensating wage adjustments has become more intense. In 1944, negotiations between coal-mine operators and miners were so prolonged that the threat of a strike of indefinite duration forced the Government to assume control of the mines for several months. Efforts to induce the War Labor Board to revise the Little Steel Formula were unsuccessful, but within its framework many wage increases were granted. One of the most significant of these was the "portal-to-portal" pay approved as one of the provisions of the wage agreement in the bituminous-coal industry. The validity of this principle has been tested in the courts and reaffirmed.

Another trend of more than current interest is the development of foremen's unions. Historically, foremen have been considered to be representatives of management and therefore not eligible to organize under the National Labor Relations Act. A body of opinion now holds that foremen are essentially employees and as such they can organize for collective bargaining under the act. The movement has become strong enough in the mining industry so that a strike of supervisors forced the Government to seize coal mines to prevent a serious interruption of output. At the end of the year the status of foremen's unions was being studied by both the National Labor Relations Board and the National War Labor Board.

In accordance with the provisions of the Fair Labor Standards Act, on March 22, 1944, the United States Department of Labor established a minimum wage of 40 cents per hour for the metal ore, coal, petroleum, and natural gas industries.

SAFETY

The over-all safety record of the mineral industries in the United States improved in 1944 and was appreciably more favorable than in any year since the start of complete injury statistics on mining and quarrying in 1930. The record in 1944 was attained despite such war-time handicaps as loss of skilled workers to the armed forces, maintenance of production at high levels with a reduced labor force, and the tiring effects of the longer workdays and work year on employees. A combined frequency rate of fatal and nonfatal injuries of 56.01 per million man-hours of exposure to hazards was achieved in 1944 by the estimated total of 693,800 employees who worked slightly more than $1\frac{1}{2}$ billion man-hours in 1944. The corresponding rate in 1943 was 56.85 and in 1934 76.81. Fatal injuries in 1944 occurred at a rate of 1.00 and nonfatal injuries at a rate of 55.01 per million man-hours of exposure. These frequencies also were lower than the corresponding rates in any year since the statistical series began in 1930.

Preliminary figures indicate that accidents during 1944 resulted in injury to 87,954 employees, approximately 3,400 fewer injuries

than occurred in 1943. In 1944 there were 86,391 nonfatal injuries that disabled the worker for longer than the day on which the accident occurred. Fatal injuries during the year totaled 1,563. During 1944, there were four major disasters in which 94 men lost their lives—22 in explosions of gas or dust and 72 in mine fires. All occurred in bituminous-coal mines. In 1943, 161 lives were lost in 7 major disasters.

The safety record in 1944 in the coal-mining industry made the greatest improvement over 1943 of any of the mineral industry groups. This improvement is of special significance because fewer workers in the bituminous-coal mines increased production to a record annual total in 1944 and likewise a reduced labor force in the anthracite industry produced more coal than in 1943. In the metal- and non-metal-mining groups, the injury records also were more favorable than in 1943. The moderate improvement in metal mines resulted from lower frequencies of injuries during 1944 in copper, gold, and silver lode mines and miscellaneous metal mines. The injury-frequency rates of the quarry and coke industries were higher in 1944 than in 1943. In metallurgical plants the over-all safety record was only slightly less favorable than in 1943, owing to a slightly higher frequency of injuries in smelters and associated works which was not compensated entirely by the improvement in mineral-dressing mills and associated works.

GOVERNMENT STOCK-PILING ACTIVITIES

Stock-piling for war.—Favorable developments on the battle fronts have been reflected in changes in the stock-pile objectives established by the war agencies. Early in the war Government stock-pile goals for some strategic and critical materials were set as high as a full 3-year emergency supply. Few if any of these were ever reached, but by August 1943 the war outlook had improved to a point where the War Production Board felt justified in reducing the objectives to a 1-year supply. A factor contributing to this decision was the growing alarm at the mounting stocks which constituted a threat to raw material markets should they be dumped at the termination of the war. In February 1944 the War Production Board again reduced its goals to 3 months' total requirements or 1 year's requirements less anticipated North American production, whichever was higher.

On October 31, 1944, a further reduction to 3 months' total requirements or 6 months' imports, whichever was greater, was adopted. At the same time the stock-pile formula, which heretofore had included only Government-owned material, was broadened to include industry stocks in excess of safe working inventories. This policy prevailed until after V-E day, when the increase in the territory from which strategic materials could be obtained, the reduction of war hazards to shipping, and lower military requirements made possible a further reduction of stock-pile objectives. In June 1945 the War Production Board abandoned the total requirements base and authorized goals equivalent to only 3 months' military requirements at the rates established in the second quarter of 1945. The new formula applied only to Government-owned inventories. Provision was made as usual for special treatment of exceptional cases.

Although the trend of Government stocks of most minerals was upward during 1944, inventories of several commodities were lower at the end of the year than at the beginning. Substantial reductions are anticipated in 1945.

Stock-pile legislation.—None of the stock-piling bills introduced and considered by the Seventy-eighth Congress was enacted into law. (See Minerals Yearbook, 1943.) However, the Surplus Property Act of 1944, approved October 3, 1944, contained a stock-piling provision designed to freeze in permanent stock piles the surplus stocks of strategic and critical materials on hand at the end of the war. Section 22 of the act reads as follows:

(a) All Government-owned accumulations of strategic minerals and metals, including those owned by any Government corporation, shall be transferred by the owning agency, when determined to be surplus pursuant to this Act, to the account of the Treasury Procurement Division and shall be added to the stock pile authorized by the Act of June 7, 1939 (53 Stat. 811), as amended, and shall be subject to its provisions: *Provided*, That contractor inventory shall be so transferred only when the owning agency has taken possession of and determined such inventory to be surplus. The minerals and metals may be transferred in any form in which they are held, but the owning agency or the Treasury Procurement Division is authorized either before or after such legal transfer to cause such minerals or metals to be put into forms best suited for storage and use for the common defense. As used in this section the phrase "strategic minerals and metals" means copper, lead, zinc, tin, magnesium, manganese, chromite, nickel, molybdenum, tungsten, mercury, mica, quartz crystals, industrial diamonds, cadmium, fluor spar, cobalt, tantalite, antimony, vanadium, platinum, beryl, graphite (and to which may be added aluminum or any other minerals or metals in such quantities or amounts as the Army and Navy Munitions Board may determine to be necessary for the stock pile authorized by the Act of June 7, 1939), and shall include ores, concentrates, alloys, scrap, and partially and completely fabricated articles of which the principal components by value consist of such minerals and metals, but shall not include such fabricated articles as the Army and Navy determine are not suitable for their use in the form in which fabricated and which may be disposed of commercially at value substantially in excess of the metal market price of the component minerals and metals of such fabricated articles.

(b) Pending a determination by the War Production Board that the supplies of the respective strategic minerals and metals available to industry are sufficient to meet the current requirements of industry, the owning agency subject to the regulations prescribed by the Surplus Property Board shall withhold from transfer under this section an amount of such minerals and metals equal to the deficiency, if any, estimated by the War Production Board as likely to exist for the requirements of industry for a period of six months for purposes other than war production; and may dispose of the minerals and metals so withheld to the extent necessary to meet any such deficiency actually found to exist by the War Production Board, at the market price of the respective minerals and metals.

(c) Any Government-owned accumulations of strategic materials shall at the request of the War and Navy Departments be transferred by the owning agency, when determined to be surplus pursuant to this Act, to the account of the Treasury Procurement Division and shall be added to the stock pile authorized by the Act of June 7, 1939 (53 Stat. 811), as amended, and shall be subject to its provisions. The materials may be transferred in any form in which they are held and they shall thereafter be put into forms best suited for storage and use for the common defense. The term "strategic materials" as used in this subsection means all materials except strategic minerals and metals as defined in subsection (a) of this section and includes all materials in group A or in group B of the list of strategic and critical materials determined upon by the Army and Navy Munitions Board on March 6, 1944, as amended from time to time, but shall not include any of such materials which the Army and Navy determine do not meet the specifications suitable for common defense or are in excess of the needs thereof. The Army and Navy Munitions Board is authorized to direct the removal from the list of any of the materials as defined in this subsection, in which event they shall be disposed of under the provisions of this Act.

(d) Within three months following the enactment of this Act the Army and Navy Munitions Board shall submit to Congress its recommendations respecting

the maximum and minimum amounts of each strategic mineral or metal which in its opinion should be held in the stock pile authorized by the Act of June 7, 1939. After one year from the submission of such recommendations, unless the Congress provides otherwise by law, the Board may authorize the proper disposal agencies to dispose of any Government-owned accumulations of strategic minerals and metals including those owned by any Government corporation when determined to be surplus pursuant to this Act.

This bill generally was regarded as a stop-gap measure to prevent dumping of surplus stocks should the war terminate before permanent stock-pile legislation was enacted. Paragraph (d) of section 22 limits the mandatory transfer of inventories to a period ending 1 year after the submission of the Army and Navy Munitions Board report on minimum and maximum stock-pile requirements. This report was submitted on January 2, 1945 (S. Doc. 5, 79th Cong., 1st sess.), so that after January 2, 1946, the transfer of surplus stocks to permanent stock piles is left to the discretion of the Surplus Property Board. As of July 1945 no material had yet been declared surplus or added to the permanent stock piles, and the outlook for any appreciable contribution to the solution of the postwar strategic material problem under this act was unfavorable.

In March 1945 identical bills, S. 752 and H. R. 2624, were introduced into the Senate and the House of Representatives by the chairman of the respective Military Affairs Committees. These bills would establish a permanent stock-piling program, including the freezing of postwar surplus stocks of strategic and critical materials, the procurement of adequate additional supplies after the war, and the encouragement of the conservation and development of sources of these materials within the United States. Hearings are planned for the fall of 1945, and as of July the bills were being studied by the executive departments of the Government.

Army and Navy Munitions Board Report.—In preparing the report on minimum and maximum stock-pile requirements called for in section 22 (d) of the Surplus Property Act of 1944 (Public Law 457, 78th Cong.), the Army and Navy Munitions Board, with the concurrence of the Secretary of the Interior, presented a detailed analysis of the strategic material problem. The report outlines the needs for stock-piling, the development of stock-pile policy, and the accomplishments under the wartime program. Although the minimum and maximum stock-pile objectives were not made public for reasons of security, the principles upon which they were determined and the lists of strategic and critical materials were given in the report. The definitions and lists as approved by the Board on November 20, 1944, were as follows:

Current list of strategic and critical materials

(The following forms an inseparable part of the strategic and critical materials list)

1. The definition of strategic and critical materials is as follows: "Strategic and critical materials are those materials required for essential uses in a war emergency, the procurement of which in adequate quantities, quality, and time is sufficiently uncertain for any reason to require prior provision for the supply thereof."

2. Within the above definition, materials are listed either in group A, group B, or group C, according to the following provisions:

(a) Group A comprises those strategic and critical materials for which stock-piling is deemed the only satisfactory means of insuring an adequate supply for a future emergency.

(b) Group B comprises additional strategic and critical materials, the stock-piling of which is practicable. The Army and Navy Munitions Board recommends their acquisition only to the extent they may be made available for transfer from Government agencies because adequacy of supply can be insured either by stimulation of existing North American production or by partial or complete use of available substitutes.

(c) Group C comprises those strategic and critical materials which are not now recommended for permanent stock-piling because in each case difficulties of storage are sufficient to outweigh the advantages to be gained by this means of insuring adequate future supply.

3. Materials in group A may be acquired in the manner prescribed for group B. Materials in all three groups are subject to constant surveillance and review. Additions to, or deletions from, the list, or movement of materials between groups, may be made, based upon future changes in their strategic and critical status.

4. The conduct of a war requires the use of an encyclopedic list of semiprocessed and processed materials, such as aviation gasoline, synthetic rubber, chemicals, drugs, ferroalloys, steel, light metals, etc. Elevation from peacetime production to a wartime footing will necessitate constant review of the facilities available to meet anticipated requirements.

GROUP A

Agar.
Antimony.
Asbestos:¹
 Rhodesian chrysotile.
 South African amosite.

Bauxite.

Beryl.

Bismuth.

Cadmium.

Castor oil.²

Celestite.

Chromite:

 Metallurgical grade.

 Refractory grade:

 Rhodesian origin.

 Other origin.

Cobalt.

Coconut oil.²

Columbite.

Copper.

Cordage fibers:²

 Manila.

 Sisal.

Corundum.

Diamonds, industrial.

Emetine.

Graphite:

 Amorphous lump.

 Flake.

Hyoscine.

Iodine.¹

Jewel bearings:

 Instrument jewels, except V jewels.

 Sapphire and ruby V jewels.

 Watch and timekeeping device jewels.

Kapok.²

Kyanite, Indian.

Lead.

Manganese ore:

 Battery grade.

 Metallurgical grade.

Mercury.

Mica:

 Muscovite block and film, good stained and better.

 Muscovite splittings.

 Phlogopite splittings.

Monazite.

Nickel.

Opium.¹

Optical glass.

Palm oil.²

Pepper.

Platinum group metals:

 Iridium.

 Platinum.

Pyrethrum.²

Quartz crystals.

Quebracho.

Quinidine.

Quinine.¹

Rapeseed oil.²

Rubber:^{1,2}

 Crude rubber.

 Natural rubber latex.

Rutile.

Sapphire and ruby.

Shellac.²

Sperm oil.²

Talc, steatite, block or lava.

Tantalite.

Tin.

Tung oil.²

Tungsten.

Vanadium.

Zinc.

Zirconium ores:

 Baddeleyite.

 Zircon.

¹ Require special storage conditions.

² Require rotation of stocks.

³ Stocks to be held by Treasury Department, Bureau of Narcotics.

GROUP B

Aluminum.
Barite.
Chalk, English.
Chromite, chemical grade.
Cryolite, natural.
Diamond dies.
Emery.
Fluorspar :
 Acid grade.
 Metallurgical grade.
Graphite, crystalline fines.
Magnesium.¹

Mica :
 Muscovite block, stained and lower.
 Phlogopite block.
Molybdenum.
Platinum group metals :
 Osmium.
 Palladium.
 Rhodium.
 Ruthenium.
Selenium.
Talc, steatite, ground.
Wool.^{1,2}

GROUP C

Asbestos, Canadian chrysotile.¹
Bristles, pig and hog.¹
Burlap, jute.⁴
Cordage fibers :²
 Hemp, true American.
 Henequen.
 Jute.
Cork.³
Iron ore.
Leather :^{1,2}
 Cattle hides :

 Heavy.
 Light.
 Calf and kip skins.
Loofa sponges.¹
Lumber :
 Balsa.
 Mahogany.
Petroleum and petroleum products.^{1,2}
Radium.^{1,2}
Scrap, iron and steel.
Sesame oil.²

The minimum quantities of group A materials recommended for stock-piling were computed on the basis of certain strategic assumptions determined by the Joint Chiefs of Staff and the United States consumption (including military, lend-lease, and essential civilian requirements) during the peak year of the present war. In addition, the figures reflected the following considerations :

- (a) Compensation for any known depletion of, or reasonably certain increases in, available resources in the United States ;
- (b) A similar compensation for known anticipated changes in resources of material outside the United States (as to which we have comparatively meager information at the present time) ;
- (c) Adjustment for anticipated increases or decreases in future military requirements as the result of technological changes already evident ;
- (d) Adjustments wherever consumption data indicate that it has been necessary to use inferior grades of material in the present war ; and
- (e) Limitations imposed upon the stock piles of perishable materials by reason of the necessity of rotating the quantities involved.

The maximum quantities of group A materials were determined on the basis of the following additional considerations needed to provide additional security.

- (a) Supply from foreign sources as it may be affected in a future emergency by international political and economic conditions ;
- (b) The inordinate expenditures of manpower, equipment, and money which may be required to build up supplies of certain materials ;
- (c) Maintenance of an industrial economy at a higher level of efficiency than that prevailing during the current emergency by minimizing drastic dislocations resulting from critical shortages ; and
- (d) Requirements as they may be affected by the civilian needs of a population of the United States larger than the present population.

¹ Require special storage conditions.
² Require rotation of stocks.

The minimum quantities recommended for group B materials were zero because supplies could be assured by means other than stock-piling. Maximum quantities were established on the basis of considerations similar to but not identical with those used for calculating group A maximums.

The report wisely calls attention to the fact that within practical limits the larger the stock pile, the greater degree of security provided. The maximum quantities recommended for nonperishable items represent the largest quantities for which the Board felt the expenditure of public funds was justified.

The report also emphasizes the need for constant review and revision of strategic and critical lists and stock-pile objectives to reflect changes in technology and shifts in political and economic factors that affect the strategic status of raw materials.

The following suggestions as to future stock-pile legislation were offered:

We recommend that the Congress adopt further stock-piling legislation in order to eliminate certain undesirable features of established policies relating to the procurement and release of materials for Government stock-piling. In view of the substantial depletion of domestic resources during the present war, statutory domestic preference requirements, allowing a year for deliveries from domestic production and the preference for domestic materials, as provided in the act of June 7, 1939, and the Buy American Act, respectively, are too restrictive. We believe that these requirements must be relaxed. Provision should also be made to permit the disposal of materials in stock piles which have become obsolete, due to technological developments, as well as to permit rotation of those which are subject to deterioration.

We further emphasize that the acquisition of stock piles in even the minimum quantities recommended in this report must be a gradual process, and will require periods ranging from 1 to 10 years, depending upon the material to be accumulated. This is because production of some of the materials in normal times is little beyond normal requirements of peacetime industry. In view of this fact, and the likelihood that in a future war we shall not have the time required to make the necessary provision for materials, it is important that an early beginning be made toward accomplishing a sound stock-pile program.

Closely related to stock-piling are several other measures that should be given consideration in connection with any plan for the supply of strategic materials in war. On account of the direct bearing which these measures have on the kinds and quantities of materials that should be stock piled, it seems appropriate to include them under these suggestions for future legislation. We refer to provisions for stand-by facilities, pilot-plant operations, continuous technological research, and the development of more economical processes for the utilization of domestic marginal resources.

GOVERNMENT ORGANIZATION FOR WAR

Recent editions of Minerals Yearbook have presented a brief summary of the Government agencies administering the war program with a view to preserving a chronological record of the major changes in organization and key personnel that affect the mineral industries. Minerals Yearbook, 1943, presented the story up to July 1944, and this review carries the record forward to July 1945. Details of the various actions taken by these agencies are given in the commodity chapters of this volume.

Although there were many internal changes in the organization and personnel of the war agencies in the latter half of 1944 and the first half of 1945, there were few significant modifications, and those were concerned chiefly with the approaching problems of reconversion. The Office of War Mobilization and Reconversion was estab-

lished as an independent agency pursuant to an act of Congress approved October 3, 1944. The new agency, which absorbed the functions of the Office of War Mobilization created by Executive order on May 27, 1943, is responsible for the development of unified programs and the establishment of policies for the maximum use of the Nation's resources, including civilian manpower; the unification of the activities of the Federal agencies concerned with the production, procurement, distribution, or transportation of supplies and materials; the issuance of such directives to Federal agencies as appear necessary to the conduct of the war; and the formulation of plans and the issuance of such orders as are required to meet the problems arising from the transition from war to peace. In effect the agency was charged with supervision of the activities of all Government agencies dealing with war production, civilian manpower, the civilian economy, and reconversion. James F. Byrnes was named Director, with Fred Searls, Jr., Deputy Director for Production Liaison and Coordination. Byrnes resigned in April 1945 and was succeeded by Fred M. Vinson. John W. Snyder replaced Vinson in July 1945 when the latter was appointed Secretary of the Treasury.

The Surplus Property Act of 1944, approved October 3, 1944, established a Surplus Property Board of three members within the Office of War Mobilization and Reconversion. The act also prescribed the principles that would guide the disposal of surplus property after the war. The Board was authorized to provide general supervision and direction over the care, handling, and disposition of surplus property, including stocks of strategic and critical minerals and Government-owned metal and mineral processing plants, and the transfer of surplus property between Government agencies. Guy M. Gillette was appointed Chairman of the Board and Robert A. Hurley and Edward H. Heller members. Mason Britten was appointed Administrator for the Board. The functions of the Surplus War Property Administration, created by an Executive order dated February 21, 1944, were transferred to the new Board. Prior to the transfer W. L. Clayton, Administrator, and G. Temple Bridgman, Deputy Administrator, had resigned from the Surplus War Property Administration. After a few months' service Gillette announced his desire to resign, stating that the Surplus Property Act required revision if the Board were to become an effective organization. Among the changes recommended were that the Board be replaced by a single surplus-property administrator and that real surplus-property-disposal authority be placed in an agency independent of the Office of War Mobilization and Reconversion. In July 1945, W. Stuart Symington was confirmed as the new Chairman of the Board, and legislation was introduced into Congress to amend the Surplus Property Act along lines suggested by Gillette.

Other recent major developments include the resignation of Donald H. Nelson, who had held a prominent position in the defense and war programs since 1940, as Chairman of the War Production Board and the appointment of J. A. Krug as his successor; the reestablishment of the Federal Loan Administration as an independent agency and the appointment of Fred M. Vinson as Administrator (later succeeded by John W. Snyder); the appointment of William H. Davis, formerly Chairman of the National War Labor Board, as Director of the Office of Economic Stabilization, vice Vinson; and the appoint-

ment of George W. Taylor to the chairmanship of the National War Labor Board. Other changes in the organizations chiefly concerned with the mineral activities of the war program are recorded below.

War Production Board.—Changes in the War Production Board since June 1944 have been chiefly in personnel; organization changes have been relatively unimportant. In July 1944 James Douglas, formerly Director of the Zinc Division, succeeded Howard I. Young as Deputy Vice Chairman for Metals and Minerals Production and also took over direction of the Mineral Resources Coordinating Division and the chairmanship of the Minerals and Metals Advisory Committee, the Mineral Resources Operating Committee, and the Mineral Classification Committee. The Zinc Division was then merged with the Tin-Lead Division under Erwin Vogelsang, Director, with Myron L. Trilsch Deputy Director for Zinc. George C. Heikes, formerly Director of the Zinc Division, was recalled in July as Director of the Aluminum-Magnesium Division; T. E. Covel was named Deputy Director in October. Heikes resigned in March 1945 and was succeeded by Nigel H. Bell. Also in July 1944 the War Production Board announced the appointment of Dr. Donald B. Keyes as Director of the Office of Production Research and Development, vice Harvey N. Davis who resigned.

A major shake-up occurred the latter part of August following rumors of dissension in the top command. Executive Vice Chairman Charles E. Wilson resigned, Chairman Donald M. Nelson was sent on a special mission to China, and J. A. Krug was named Acting Chairman. Nelson's resignation was accepted early in October, and Krug was named Chairman.

Early in September L. R. Boulware, Operations Vice Chairman, returned to industry and was succeeded by Hiland G. Batcheller, who had resigned from the same post in November 1943. On September 1, Richard J. Lund, Director of the Miscellaneous Minerals Division, resigned, and James S. MacGregor, Deputy Director, was elevated to the post. At the end of May 1945 MacGregor returned to private life and was succeeded by F. G. Rockwell, then Deputy Director. Later in September Krug announced that Deputy Executive Vice Chairman Arthur H. Bunker had been shifted to the position of Chief of Staff and Batcheller had been named Chief of Operations. These changes were announced as major moves in the streamlining of the Board's organization to deal with reconversion. Harold Boeschstein later became Operations Vice Chairman, and Bunker stepped out in December. Bunker's position was not filled until May 1945, when John D. Small, who had been serving as Executive Officer of the Board, was appointed to the post.

M. H. Billings, Director of the Mica-Graphite Division, left the War Production Board in October, whereupon the Division was consolidated with the Miscellaneous Minerals Division. Stacy May, Chief of the Bureau of Planning and Statistics (subsequently renamed Bureau of Program and Statistics), returned to private employment October 1 and was replaced by Bertrand Fox.

The Quota Committee for the Premium Price Plan was reorganized in November to provide a nonvoting Chairman. The Committee continued as before with 6 voting members—3 from the War Production Board and 3 from the Office of Price Administration. Ellsworth R. Bennett was appointed Chairman, and Landon Strobel was retained

as Executive Secretary. Frank H. Hayes, the former Chairman, was elevated to the post of Assistant Director of the Copper Division in charge of production. He continued temporarily as a voting member of the Committee but was succeeded in December by Edward J. Craig as the representative of the Copper Division. Bennett returned to the mining industry in May 1945 and was succeeded by Roland D. Parks, who continued also to serve as Assistant Deputy Vice Chairman for Production.

In December the Mineral Resources Coordinating Division was abolished as an organizational unit, and its functions were transferred to the Office of the Vice Chairman. Wilbur A. Nelson, who had served as Deputy Director of the Division, resigned to enter private employment.

Indicative of the extent to which Government action in the industrial field had diminished was the announcement that the staff of the Steel Division had been reduced from a peak of 800 to less than 250 on November 30. During the past year the Division organization has been simplified. In December William F. Todd succeeded Norman W. Foy, who resigned as Director but later returned as a special assistant to the Chairman of the Board. H. M. Francis was made Deputy Director.

Late in February Philip D. Wilson, who had succeeded Bunker as Vice Chairman for Metals and Minerals in June 1944, was shifted to a position of Special Assistant to the Chairman; W. C. Keeley assumed the vacated post. Early in May the resignations of Wilson and S. W. Anderson, Program Vice Chairman, were announced, Lincoln Gordon taking the latter's place. Near the end of June the appointment of R. C. Allen as Deputy Vice Chairman for Metals and Minerals was announced, and 2 weeks later he was designated Vice Chairman, succeeding Keeley, who returned to industry. Allen previously had served over 2 years in the War Production Board and its predecessors, having resigned the post of Deputy Director of the Steel Division in charge of raw materials in August 1942.

As of July 1945, the members of the War Production Board and the principal staff officers dealing with policy or administration affecting the mineral industries were as follows:

WAR PRODUCTION BOARD

Members

Chairman.....	J. A. Krug.
Secretary of War.....	Henry L. Stimson.
Secretary of the Navy.....	James Forrestal.
Secretary of Agriculture.....	Clinton P. Anderson.
Federal Loan Administrator.....	Vacancy.
Administrator, Office of Price Administration.....	Chester Bowles.
Foreign Economic Administrator.....	Leo T. Crowley.
Chairman, War Manpower Commission.....	Paul V. McNutt.
Director, Office of Defense Transportation.....	J. M. Johnson.
Petroleum Administrator for War.....	Harold L. Ickes.
Director of Contract Settlement.....	Robert H. Hinckley.

Staff

Chief of Staff.....	John D. Small.
Assistant to the Chairman.....	Charles H. Ketcham.
Office of Production Research and Development, Director.....	Donald B. Keyes.
Metals and Minerals Branch, Chief.....	C. K. Leith.

WAR PRODUCTION BOARD—Continued

Staff—Continued

Bureau of Program and Statistics, Director.....	Bertrand Fox.
Office of War Utilities, Director.....	Edward Falck.
Vice Chairman for Smaller War Plants.....	Maury Maverick.
Vice Chairman for Civilian Requirements.....	W. Y. Elliott.
Program Vice Chairman.....	Lincoln Gordon.
Vice Chairman for Field Operations.....	James A. Folger.
Vice Chairman International Supply.....	William L. Batt.
Division of Stock-piling and Shipping, Chief.....	Morton Banks.
Vice Chairman for Labor Production.....	Joseph D. Keenan.
Vice Chairman for Manpower Requirements.....	Clinton S. Golden.
Operations Vice Chairman.....	Harold Boeschstein.
Vice Chairman for Metals and Minerals.....	R. C. Allen.
Executive Assistant.....	Albert Butler.
Deputy Vice Chairman for Production.....	James Douglas.
Assistant Deputy Vice Chairman for Production.....	Roland D. Parks.
Mineral Resources Operating Com- mittee:	
Chairman.....	James Douglas.
Alternate Chairman.....	Roland D. Parks.
Bureau of Mines.....	R. S. Dean.
Foreign Economic Administra- tion.....	Alan M. Bateman.
Reconstruction Finance Cor- poration.....	Simon D. Strauss.
Office of Production Research and Development.....	C. K. Leith.
Minerals and Metals Advisory Com- mittee:	
Chairman.....	James Douglas.
Alternate Chairman.....	Roland D. Parks.
War Department.....	Lt. Col. John A. Church.
Navy Department.....	Comdr. J. W. Palen.
Bureau of Mines.....	R. S. Dean.
Metals Reserve Company.....	Simon D. Strauss.
Geological Survey.....	Donnel F. Hewett.
Foreign Economic Administra- tion.....	Alan M. Bateman.
Bureau of Foreign and Domes- tic Commerce.....	Walter Janssen.
Office of Civilian Requirements.....	Carroll Burton.
Office of Production Research and Development.....	C. K. Leith.
State Department.....	Charles E. Gamper.
Labor Production Division.....	Clinton Golden.
Stock-piling and Transporta- tion Division.....	Morton M. Banks.
Premium Price Quota Committee	
Chairman.....	Roland D. Parks.
Secretary.....	Landon F. Strobel.
War Production Board, Tin- Lead-Zinc Division.....	C. A. Wright.
War Production Board, Tin- Lead-Zinc Division.....	Edgar E. Barker.
War Production Board, Copper Division.....	Edward J. Craig.
Office of Price Administration.....	Jesse L. Maury.
Office of Price Administration.....	J. J. Beeson.
Office of Price Administration.....	C. O. Mittendorf.
Aluminum and Magnesium Division, Director.....	Nigel H. Bell.
Deputy Director.....	T. E. Covel.

WAR PRODUCTION BOARD—Continued

*Staff—Continued*Vice Chairman for Metals and Minerals—
Continued.

Copper Division, Director.....	Michael Schwarz.
Assistant Director.....	Frank H. Hayes.
Assistant Director.....	John J. Hines, Jr.
Steel Division, Director.....	William B. Todd.
Deputy Director.....	H. M. Francis.
Assistant Director for Manpower...	Philip J. Clowes, Acting.
Assistant Director for Production...	R. F. Sentner.
Assistant Director for Raw Materials and Facilities.	H. J. French.
Plant Facilities Branch, Chief...	H. W. Bryant.
Metallurgical Branch, Chief...	E. J. Hergenroether.
Raw Materials Branch, Chief...	Alex Miller.
Assistant Director for Ferro-Alloys and Alloy Steels.	Louis E. Creighton.
Cork, Asbestos and Fibrous Glass Division, Director.	William T. Meloy.
Deputy Director.....	J. E. Cole, Acting.
Mining Division, Director.....	Arthur S. Knolzen.
Deputy Director.....	Marcellus H. Stow.
Miscellaneous Minerals Division, Director.	F. G. Rockwell.
Deputy Director.....	Frank F. Watts.
Tin-Lead-Zinc Division, Director.....	Erwin Vogelsang.
Deputy Director.....	S. K. Butterworth.
Deputy Director.....	Myron Trilsch.

Office of Price Administration.—During the year the Office followed the same general policies in the pricing of minerals, and no change was made in the standards governing price increases. Moderate increases were granted in the maximum prices for solid fuels and for certain nonmetallic minerals. No price increases were authorized for any of the basic metals, although increases were permitted for some steel products. Throughout 1944 the premium price plan for copper, lead, and zinc remained in effect.

Chester Bowles continued as Administrator and James F. Brownlee as Deputy Administrator for Price. As of May 15, 1945, the following units and executives of the Price Department were administering prices for minerals:

Industrial Materials Price Division, Director.....	John S. Clement.
Building Materials Branch, Price Executive....	Karl Mathiasen.
Iron and Steel Branch, Price Executive.....	Warren M. Huff.
Nonferrous Metals Branch, Price Executive....	Karl L. Anderson.
Metal Mining Analysis Office, Director.....	Jesse L. Maury.
Industrial Manufacturing Price Division, Director.	John S. Clement.
Rubber, Chemicals and Drugs Branch, Price Executive.	Lester V. Chandler.
Fuel Price Division, Director.....	Sumner T. Pike.
Associate Director.....	Orville Judd.
Petroleum Branch, Price Executive.....	Eugene D. Uman.
Solid Fuels Branch, Price Executive.....	J. H. Reppert.

Petroleum Administration for War.—The organization and functions of this war agency were essentially the same in 1944 as in 1943, although some administrative adjustments were made to meet problems posed by the changing conditions of war.

The delegation of authority to the five district Directors to rule on questions of local significance was continued and broadened in scope in 1944. The central office in Washington was thus relieved of much

detail, and expeditious handling of matters of direct concern to oil and gas operators was possible.

As the availability of materials improved during the year, controls over the spacing of wells and minor construction projects connected with production, refining, transportation, and marketing were relaxed in a series of orders. Under this program, a large percentage of the projects that formerly required specific authorization became eligible for automatic approval within the limits prescribed. These actions effected a substantial reduction in the negotiations, paper work, and attendant delays and minor irritations inherent in the regulation of routine activities of a highly complex industry.

To aid the petroleum industry in maintaining a sufficient force for the required rate of operations during periods of critical manpower shortage, the Petroleum Administration became the claimant agency for deferment from the draft of the industry's essential workers 18 to 26 years of age. Manpower counselors were attached to three of the five district offices (Chicago, Houston, and Los Angeles) to assist in keeping industry informed concerning regulations and trends in manpower programs and planning as seen from the national and regional levels and to suggest area and regional programs designed to maintain or increase, as necessary, manpower in particular branches of the industry.

The great construction program initiated by the Petroleum Administration in 1941 to equip refineries in the United States for the manufacture of unprecedented quantities of 100-octane aviation gasoline was substantially completed in 1944. Similar construction at refineries in foreign countries was approaching completion in early 1945.

PAW directs world-wide petroleum-supply operations of the United Nations in keeping with a World Supply Program developed in collaboration with the military and shipping authorities of this Government and the British and designed to assure the most effective utilization of all available petroleum production, refining, and transportation facilities. The importance of this function has grown with the prospect of utilizing more oil from foreign sources as shipping lanes are cleared of the enemy and the carrying capacity of the tanker fleet increases. Organization machinery for interagency coordination with respect to foreign petroleum problems is provided also by the Foreign Petroleum Committee, and other Government committees that have been created to deal with special aspects, such as materials procurement for foreign petroleum operations, and petroleum supply programs for the liberated areas.

The principal officials of PAW, on July 1, 1945, follow:

Administrator.....	Harold L. Ickes.
Deputy Administrator.....	Ralph K. Davies.
Executive Assistant to Deputy Administrator.	H. Chandler Ide.
Chief Counsel.....	R. E. Hardwicke.
Production Division.....	J. R. McWilliams, Director.
Natural Gas and Natural Gasoline Division.	J. E. Pew, Director.
Supply and Transportation Division....	G. A. Wilson, Director.
Refining Division.....	A. P. Frame, Director.
Distribution and Marketing Division....	W. Hochuli, Director.
Foreign Production Division.....	W. B. Heroy, Director.
Foreign Refining Division.....	O. S. Snodgrass, Director.

Foreign Supply and Distribution Division	R. F. Hawkins, Director.
Materials Division	E. E. Robbins, Director.
Facility Security Division	W. K. McCoy, Director.
Research Division	E. B. Swanson, Director.
Public Relations Division	Ludwig Caminita, Jr., Director.
Program Division	W. H. Page, Director.
Executive Officer	W. H. Newman.
Labor-Manpower Counselor	G. E. Dewey.

Solid Fuels Administration for War.—The origin and functions of this agency were described briefly in *Minerals Yearbook*, 1943.

Harold L. Ickes continued as Administrator and Charles J. Potter as Deputy Administrator during the past year. Various actions taken by this agency during 1944 are presented in the chapters of this volume covering coal and coke.

The Coal Mines Administration, set up in July 1943 to supervise the operation of coal mines in Government possession, was liquidated on September 15, 1944, and its responsibilities were turned over to the Solid Fuels Administration.

Two bituminous-coal mines taken over by the Coal Mines Administration continued in Government possession under the Solid Fuels Administration. In addition, by separate Executive orders, the properties of one anthracite-mining company and 73 bituminous mines were taken over in the summer and fall of 1944 as a result of labor disputes. All these mines, except the original 2, were returned to private ownership in the winter of 1944-45. In April and May 1945, under Executive Orders 9536 and 9548, the Solid Fuels Administration took over 272 bituminous-coal mines, 2 Virginia anthracite mines, and the properties of 363 anthracite companies that were strike-bound as a result of wage disputes.

In May 1944 the Economics and Statistics Division of the Solid Fuels Administration for War was transferred to the Bureau of Mines, where it was consolidated with the Coal Economics Division of the Economics and Statistics Branch.

As of June 1, 1945, the organization of the Solid Fuels Administration for War was as follows:

Administrator	Harold L. Ickes.
Deputy Administrator	Charles J. Potter.
Assistant Deputy Administrator for Prices, Manpower and Administration	Dan H. Wheeler.
Assistant Deputy Administrator for Coke	Harlen M. Chapman.
Assistant Deputy Administrator for Transportation	Clark M. Groninger.
Assistant to the Deputy Administrator	Charles H. Hayes.
Head Administrative Officer	John E. MacDonald.
General Counsel	Jesse B. Messitte.
Chief, Anthracite Distribution Division	Thomas G. Valteau.
Chief, Bituminous Distribution Division	William F. Hahman.
Chief, Compliance Division	Thomas J. O'Brien.
Chief, Conservation and Information Division	Leonard W. Mosby.
Personnel Officer	George C. Dickens.
Chief, Budget and Administrative Services Division	Waldron E. Leonard.
Chief, Field Office Division	Newton O. Wood, Jr.

Advisory bodies providing counsel to the Solid Fuels Administration include the following:

Solid Fuels Advisory War Council.
National Anthracite Distribution Committee.
Regional Anthracite Distribution Committee.

Producer Advisory Boards for the 22 bituminous coal production districts.
 Lake Dock and Tidewater Dock Advisory Committees.
 National Advisory Coke Committee.
 National Committee on Local Distribution.
 Area Advisory Committees on Local Distribution.
 Community Committees on Emergency Distribution.

Foreign Economic Administration.—This agency, successor to the Board of Economic Warfare and Office of Economic Warfare, which was created within the Office of Emergency Management by Executive Order 9380 issued on September 25, 1943, directs the foreign economic activities of the United States Government, including the procurement of metals and minerals from abroad. Leo J. Crowley is the Administrator.

The Agency operates through two major bureaus—a Bureau of Supplies, of which Sidney H. Scheuer is Executive Director, and a Bureau of Areas, directed by Arthur Paul. Foreign procurement of commodities is carried on in a Foreign Procurement and Development Branch, of which Arthur Z. Gardiner is Director.

The development and procurement of foreign minerals are handled by the FEA, and purchases are made in the name of its corporate fiscal agent, United States Commercial Company, a United States Government-owned corporation. This has been true since September 1943, when the foreign procurement functions of the Metals Reserve Company were transferred to United States Commercial Company. In general, Metals Reserve Company, an RFC subsidiary, purchases foreign metals and minerals from United States Commercial Company ex-dock at United States ports of entry or f. o. b. cars at border points and undertakes the domestic sale and distribution of such materials. This transfer signaled completion of the withdrawal of the RFC from the foreign minerals procurement field, with the exception of continued responsibility for some large development projects, financed by the Defense Plant Corporation and the Metals Reserve Company.

With this exception, actual operations in the foreign minerals procurement field are conducted by the Metals and Minerals Divisions of the Foreign Procurement and Development Branch in the FEA. Key officials on the technical staff of these two Divisions and of the Associated Technical Services Division were as follows on July 1, 1945:

Associate Director of Foreign Procurement and Development Branch in charge of Metals and Minerals—Alan M. Bateman

Metals Division, Chief.....	Mahlon M. Miller.
Assistant Chief.....	Horace J. Fraser.
Copper Section, Chief.....	William C. Schmidt.
Zinc-Lead Section, Chief.....	F. R. McIntosh.
Tin, Mercury, Antimony, Bauxite Section, Chief.....	Clarence E. Peterson.
Ferro-Alloy Section, Chief.....	Cayford Burrell.
Scrap Metals Section, Chief.....	Benjamin Schwartz.
Minerals Division, Chief.....	Hugh E. McKinstry.
Mica-Graphite Section, Chief.....	Richard H. Vail.
Quartz and Abrasives Section, Chief.....	Carl Tolman.
Alloy and Rare Minerals Section, Chief.....	Robert W. Bridgeman.
Engineering Analysis and Contract Control Section, Chief.....	Robert K. Warner.
Service and Supply Section, Chief.....	Marshall Walker.

Reconstruction Finance Corporation.—This agency has had a tremendous part in carrying out the defense and war programs on the industrial front, including the construction and management of mineral processing plants and the procurement of strategic and critical minerals. The Corporation was created by act of Congress approved January 22, 1932, to extend financial assistance to commerce, agriculture, and industry by direct loans to banks and other credit agencies as a means of combating the depression. Although its powers and functions for war purposes have been broadened greatly by numerous Executive orders and amendments to the original enabling act, the Board acts largely under directives from and at the request of the Army and Navy and the other war agencies.

Under the President's Reorganization Plan 1, dated April 25, 1939, the Reconstruction Finance Corporation and other credit organizations of the Government were placed within a newly created Federal Loan Agency. Jesse H. Jones, who had served as Chairman of the Corporation for many years, became Administrator of the loan agency, which position he continued to occupy after he was appointed Secretary of Commerce in 1940. On February 24, 1942, by Executive order, the Reconstruction Finance Corporation and certain other units of the Loan Agency were transferred to the United States Department of Commerce.

Following the retirement of Jones from Government service in January 1945 Congress, by an act approved February 24, 1945, reestablished the Federal Loan Agency as an independent unit of government, to which were transferred the Reconstruction Finance Corporation and other loan activities placed in the United States Department of Commerce on February 24, 1942. Fred M. Vinson was appointed Administrator of the new agency and was succeeded by John W. Snyder in April. The post was left vacant following Snyder's transfer to the Office of War Mobilization and Reconversion in July. Charles B. Henderson is Chairman of the Board of Directors of the Reconstruction Finance Corporation.

To carry out its war responsibilities the Reconstruction Finance Corporation created several subsidiaries, some of which, by act of Congress, effective July 1, 1945, were consolidated into the Reconstruction Finance Corporation itself. Commenting on this merger, Federal Loan Administrator Snyder stated that it was an important step toward simplification of the Corporation which was possible "now that the Nation had successfully constructed its Arsenal of Democracy." He also stated that, as of January 1945, authorizations by these subsidiary corporations, together with RFC direct commitments for war purposes of approximately \$2,600,000,000 have amounted to \$32,300,000,000. Disbursements have exceeded \$18,000,000,000, including \$1,400,000,000 for direct subsidy payments to increase or maintain production of strategic or critical materials. The latter figure does not include losses arising from the purchase and sale of such materials. Repayments of loans and advances and other receipts, such as rents, part payments on plants and equipment, and proceeds from sales of materials have totaled \$9,100,000,000.

METALS RESERVE COMPANY

A very large part of the war procurement of strategic and critical metals and minerals has been conducted by this agency. Total commitments for this purpose through 1944 aggregated \$5,174,000,000, of which \$2,150,000,000 has been disbursed and \$2,149,000,000 canceled or assigned to industry or the Foreign Economic Administration. Sales of materials, principally to war industries, have amounted to \$1,813,000,000. Stock piles on hand cost \$538,600,000; in addition, the Company has large assets such as advances to contractors and other receivables, and mining equipment and supplies in the amount of \$67,800,000.

Charles B. Henderson was President of the Company at the time of the merger. Harvey J. Gunderson was Executive Vice President, having succeeded H. Dewitt Smith, who resigned in November 1944. Following the merger Gunderson was named Executive Director of an Office of Metals Reserve. Simon D. Strauss and DeWitt C. Schieck, former Vice Presidents, were named Deputy Directors.

DEFENSE PLANT CORPORATION

Most of the war expansion of industrial capacity and plant for the production of munitions and strategic and critical materials has been conducted through this agency. Total commitments on January 1, 1945, for war plants, facilities, and machine tools were \$10,704,935,000, of which \$757,656,000 had been canceled and \$7,177,700,000 disbursed. These commitments included 920 complete, integrated plants, wholly owned by the Corporation, involving \$6,055,000,000, and expansions at 122 existing privately owned plants, involving \$740,000,000. These expansions are wholly owned by the Corporation and are located on land owned by it or held under long-term lease. Commitments to produce critical and strategic materials in foreign countries totaled \$42,714,850.

At the time of the merger Sam H. Husbands was President of the Corporation and Hans A. Klagsbrunn Executive Vice President. After the merger the latter was named Executive Director of an Office of Defense Plant.

DEFENSE SUPPLIES CORPORATION

Although this agency has been concerned chiefly with products other than minerals, it has had some important functions related to the mineral industries. Its operations have included the purchase of strategic and critical materials, the payment of extraordinary transportation costs in oil, coal, and sugar, and various other activities such as the making of loans and the payment of subsidies in connection with the purchase of materials. Disbursements for such purposes as of January 1, 1945, were \$5,200,000,000. Receipts from the sale of materials, repayment of loans, etc., amounted to \$3,600,000,000. Total expenditures authorized by the Corporation aggregated \$10,350,000,000, of which \$800,000,000 had been canceled or assumed by private industry.

Stuart K. Barnes, former Vice President of the Corporation, was appointed Executive Director of the Office of Defense Supplies after the merger.

STATISTICAL SUMMARY OF MINERAL PRODUCTION

(GENERAL UNITED STATES SUMMARY AND DETAILED PRODUCTION BY STATES)

By MARTHA B. CLARK AND MARIAN E. MEYER

SUMMARY OUTLINE

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INTRODUCTION

This report continues the series of annual statistical summaries published in previous years as chapters of Mineral Resources and Minerals Yearbook.

In order to meet the need of industry and the States for up-to-date statistics on State production of minerals, State summaries are presented for the current year. Because of the early date of publication, the fuel figures for 1944 are estimates subject to revision; it is believed, however, that the data shown represent a high order of accuracy.

UNIT OF MEASUREMENT

The unit of measurement used by the Bureau of Mines for each mineral product in reports on the mineral resources is that common to the industry concerned, and the variation in these units makes it impracticable, if not impossible, directly to combine and compare the different minerals except as to value. Although most of the products are measured by weight, some are measured by volume and some by number of "pieces," etc.; for some no total quantity figures are available.

ELIMINATION OF DUPLICATION

In the totals for the United States, shown in the following "general" tables, duplication has been eliminated wherever practicable, and in the State totals given in the State tables virtually all duplication has been eliminated. For instance, in both general and State tables the output of coke is shown but its value is not included in the totals, as the value of the coal used in its manufacture enters into the value of the coal production which is included in the totals. For asphalt, both native and oil are shown in the general tables, but the value of the oil asphalt is excluded from the totals as it duplicates that of the petroleum from which it is manufactured. For the clay industries, no figures have been available for total clay produced. For years before 1936, the total value of clay products is included in both general and State totals as representing the first marketable form of the

greater part of the clay produced; the quantity and value of the clay mined and sold in the raw state by miners to users of clay are shown separately also, but the value is not included in the totals as it is duplicated largely in that for clay products. For years beginning with 1936, as the Bureau of Mines believes that a closer approach to the value of domestic clay in its first marketable form results from the inclusion of the value of clay sold or shipped by producers and of clay products other than pottery and refractories, the United States and State totals include such values for the clay industries. This change in practice should be borne in mind when comparing the values beginning 1936 with those for earlier years.

United States totals.—In the general tables both iron ore and pig iron are shown, but the value of the pig iron rather than the iron ore is included in the United States totals, as that is considered the better means of presenting the statistics for iron in its first marketable form. For gold, silver, copper, lead, and zinc the value of "smelter output" is included in the general totals, and to account more fully for the value of the ores treated these smelter figures are supplemented by the value of the byproduct sulfuric acid. The value of pigments (white lead, red lead, lithopone, litharge, and orange mineral) manufactured from metals is not included in the general tables, as the base from which they are made is included in the output of lead or zinc, whereas the value of sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide is included, as these are made in large part direct from the ores and do not enter into the lead or zinc totals, which represent smelter output.

State totals.—In the State tables also iron ore and pig iron are both shown. As blast-furnace products cannot be traced to the States in which the ore is mined, the value of the ore is used in the State totals. For ores of gold, silver, copper, lead, and zinc no values are shown, and in fact none are recorded; instead, for each of these metals the recoverable content of the ores is used as the basis of valuation. The value of the zinc and lead pigments is not included in the State total, as the recoverable zinc and lead content of the ores from which the products were made is included under zinc or lead. The value of the sulfuric acid produced as a byproduct of copper, lead, and zinc smelting and zinc roasting is not included in the State total, as tracing this product back to the State producing the ore has not been possible.

GENERAL TABLES
Mineral products of the United States, 1942-44

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
METALLIC						
Aluminum.....	521,106	\$151,371,000	920,179	\$205,380,000	778,446	\$222,416,000
Antimonial lead.....	251,762	(¹)	263,515	(¹)	257,902	(¹)
Antimony.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Bauxite.....	6,980	479,600	16,785	913,576	13,501	563,296
Beryllium.....	2,940,463	12,634,025	7,406,260	32,744,109	3,162,571	14,402,467
Carbon.....	269	24,188	356	44,407	388	56,135
Chromium.....	7,233,043	5,740,082	8,326,768	6,570,546	8,551,424	6,435,124
Copper.....	178,009	61,948	137,952	108,844	283,203	213,902
Copper, sales value.....	112,876	2,994,081	160,120	4,820,461	43,629	1,698,299
Fluorite.....	1,087,991	256,766,000	1,092,939	257,934,000	1,063,379	236,797,000
Gold.....	1,869,211	259,084,063	1,995,171	271,487,609	1,860,956	246,014,039
Iron.....	3,741,806	130,963,210	1,394,522	48,808,270	1,022,238	35,778,330
Lead.....	105,988,514	279,178,751	99,462,850	209,016,546	95,135,675	256,885,512
Lead (refined), sales value.....	59,100,601	1,227,389,689	60,787,159	1,273,634,210	60,995,977	1,278,981,313
Magnesium.....	467,367	58,888,000	406,544	62,038,000	394,443	60,439,000
Manganese ore (35 percent or more Mn).....	47,420	21,216,414	170,267	69,900,802	146,585	60,141,437
Manganese ore (5 to 35 percent Mn).....	190,748	6,493,674	205,173	7,278,758	247,616	9,014,875
Mercury.....	1,769,377	4,866,602	1,722,898	4,522,052	1,487,612	3,855,946
Nickel.....	50,846	9,983,612	51,929	10,137,000	37,688	4,460,752
Ore.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Molybdenum.....	66,437,000	47,275,000	53,955,000	38,500,000	39,423,000	27,999,000
Nickel.....	612	(¹)	642	(¹)	988	(¹)
Ores (crude), old tailings, etc.:.....						
Copper.....	92,664,000	(¹)	98,120,000	(¹)	91,064,000	(¹)
Dry and siliceous (gold and silver).....	11,649,000	(¹)	4,963,000	(¹)	2,620,000	(¹)
Lead.....	7,612,000	(¹)	7,258,000	(¹)	6,805,000	(¹)
Lead-copper.....	1,000	(¹)	123,400	(¹)	123,000	(¹)
Zinc.....	9,119,000	(¹)	16,804,000	(¹)	16,470,000	(¹)
Zinc-copper.....	7,000	(¹)	813,000	(¹)	943,000	(¹)
Zinc-lead.....	18,827,000	(¹)	13,403,000	(¹)	15,418,000	(¹)
Zinc-lead-copper.....	2,000	(¹)	27,000	(¹)	19,000	(¹)
Platinum metals (refined) (value at New York City).....	35,103	1,600,000	34,917	1,455,000	33,021	1,481,000

See footnotes at end of table.

Mineral products of the United States, 1942-44—Continued

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
METALLIC—continued						
Selenium.....	316, 613	(11)	521, 779	(11)	423, 906	(11)
Silver ²	56, 090, 855	\$39, 886, 830	40, 900, 121	\$29, 084, 530	35, 651, 049	\$23, 351, 857
Tantalum and columbium ores.....	200	15, 182	15, 182	29, 086	10, 412	24, 234
Tellurium.....	98, 798	(11)	62, 260	(11)	45, 323	(11)
Tin (metallic equivalent).....	7	7, 300	7	6, 800	6	6, 200
Titanium concentrates:						
Ilmenite.....	93, 397	1, 805, 823	211, 715	3, 738, 970	280, 791	7, 371, 279
Rutile.....	2, 649	410, 956	3, 941	610, 879	6, 770	1, 088, 112
Titanium ore (60-percent concentrates).....	9, 333	13, 508, 266	11, 945	17, 973, 685	10, 282	14, 408, 519
Vanadium.....	4, 439, 130	2, 468, 100	5, 586, 492	3, 518, 493	3, 527, 054	1, 680, 578
Zinc ³ sales value.....	629, 957	\$109, 613, 000	594, 250	\$102, 211, 000	574, 453	\$98, 806, 000
Other metallic ¹¹		3, 643, 356		2, 506, 443		2, 576, 048
Total value of metallic products (approximate).....		2, 363, 900, 000		2, 488, 000, 000		2, 340, 000, 000
NONMETALLIC						
Arsenious oxide.....	31, 038	1, 360, 366	32, 423	1, 519, 706	34, 472	1, 694, 819
Asbestos.....	15, 481	498, 857	6, 014	334, 815	6, 667	380, 334
Asphalt:						
Native.....	975, 373	4, 279, 442	886, 135	4, 288, 488	789, 516	3, 691, 279
Oil (including road oil) ⁸	7, 708, 853	\$74, 612, 136	7, 131, 973	\$80, 615, 217	6, 408, 766	\$70, 310, 623
Barite (crude).....	429, 484	2, 673, 002	420, 343	2, 796, 776	618, 617	3, 583, 489
Boron minerals.....	226, 723	5, 733, 648	256, 633	6, 401, 507	277, 586	6, 576, 587
Bromine.....	65, 880, 835	13, 729, 383	94, 085, 937	19, 107, 065	102, 112, 462	19, 712, 819
Calcium-magnesium chloride.....	224, 527	1, 733, 169	199, 796	1, 549, 565	200, 964	1, 621, 227
Cement.....	187, 809, 208	286, 905, 197	129, 478, 662	202, 490, 328	95, 592, 155	151, 996, 646
Clay:						
Products (other than pottery and refractories).....		14 102, 740, 000		14 75, 000, 000		14 65, 472, 000
Raw (sold or shipped by producers).....	7, 342, 843	24, 523, 227	7, 287, 897	24, 915, 007	6, 275, 140	23, 524, 998
Coal:						
Bituminous ¹⁵	582, 692, 937	1, 373, 990, 608	590, 177, 069	1, 584, 644, 477	620, 000, 000	1, 819, 753, 000
Pennsylvania anthracite.....	60, 327, 729	271, 673, 000	60, 643, 620	306, 816, 018	63, 701, 363	354, 582, 884
Coke ⁸	70, 568, 944	\$425, 613, 744	71, 676, 063	\$476, 117, 472	74, 037, 817	\$527, 921, 506
Diatomite.....	(11)	(11)	(11)	(11)	(11)	(11)
Emery.....	5, 277	49, 413	6, 666	63, 195	6, 940	64, 858
Feldspar (crude).....	316, 166	1, 646, 702	308, 180	1, 646, 277	327, 408	1, 813, 937
Fluorspar.....	360, 316	8, 897, 749	406, 016	11, 802, 255	413, 781	12, 503, 487
Fuller's earth.....	204, 244	2, 139, 670	247, 258	2, 664, 027	294, 737	3, 297, 064
Garnet for abrasive purposes.....	4, 357	299, 904	5, 935	429, 120	(16)	(16)
Gems and precious stones.....						

	7,203	401,000	U. S. 1917	1917, 1912	U. S. 1917	1917, 1912	U. S. 1917	1917, 1912
Graphite	14,081	5,898,719	12,638	4,881,925	(12)	3,761,284	(12)	8,002,062
Crystalline	4,007,568	5,811,100	(11)	5,950,815	(11)	(11)	(11)	(11)
Grindstones and pulstones	(10)	(10)	(10)	(10)	(10)	(10)	(10)	(10)
Gypsum (crude)	8,708	100,760	0,561	238,640	(9)	0,473,563	(9)	906,153
Bellum	6,103,791	44,397,441	6,046,616	49,054,238	(8)	13,319	(8)	552,077
Iodine	5,405	3,874,816	8,156	13,319	(7)	661,450	(7)	4,407,401
Kyanite	497,368	3,874,816	764,833	0,071,696	(6)	1,028,158,000	(6)	18,863,900
Lime	738,514,000	10,737,560	1,228,146,000	21,605,241	(5)	178,086	(5)	171,699
Manganese	194,878	135,046	147,138	152,821	(4)	4,908	(4)	603,651
Magnesium compounds (natural) (including brucite)	10,110	448,640	10,046	532,124	(3)	1,080,073	(3)	3,262,711
Marl	43,292	671,165	46,138	798,025	(2)	1,523,313	(2)	6,700
Calcareous	2,701,844	725,030	3,446,199	3,226,712	(1)	3,780,232,000	(1)	8,016,452
Greensand	(1)	10,391	(1)	(1)	(1)	3,031,308,000	(1)	28,901,887
Mica	97,327	7,764,232	100,216	7,951,057	(1)	3,780,232,000	(1)	8,016,452
Scrap	150,215	21,255,125	182,827	26,240,847	(1)	3,031,308,000	(1)	28,901,887
Sheet	(1)	(1)	(1)	(1)	(1)	3,031,308,000	(1)	28,901,887
Mineral pigments	3,033,475,000	692,737,000	3,414,689,000	760,650,000	(1)	3,031,308,000	(1)	28,901,887
Natural pigments and manufactured iron oxide pigments	2,725,968,000	102,565,000	2,773,218,000	122,600,000	(1)	3,031,308,000	(1)	28,901,887
Zinc and lead pigments	773,556,000	19,000,000	910,864,000	24,410,000	(1)	3,031,308,000	(1)	28,901,887
Mineral water	(1)	(1)	(1)	(1)	(1)	3,031,308,000	(1)	28,901,887
Natural gas	5,739	45,201	5,415	48,633	(1)	3,031,308,000	(1)	28,901,887
Natural gasoline and allied products	71,500	516,887	60,002	491,490	(1)	3,031,308,000	(1)	28,901,887
Liquefied petroleum gases	1,386,645,000	1,643,470,000	1,503,613,000	1,809,020,000	(1)	3,031,308,000	(1)	28,901,887
Oilstones, etc.	4,644,240	16,597,492	5,126,232	18,962,021	(1)	3,031,308,000	(1)	28,901,887
Olive	30,680,831	22,992,518	34,732,151	26,182,072	(1)	3,031,308,000	(1)	28,901,887
Peat	136,522	706,199	85,150	61,495	(1)	3,031,308,000	(1)	28,901,887
Petroleum	720,363	2,464,000	802,384	2,844,000	(1)	3,031,308,000	(1)	28,901,887
Phosphate rock	13,693,284	38,144,234	15,214,152	43,878,266	(1)	3,031,308,000	(1)	28,901,887
Potassium salts	3,622,487	6,784,427	3,971,931	7,376,566	(1)	3,031,308,000	(1)	28,901,887
Pumice	300,724,000	181,716,000	280,092,000	145,416,000	(1)	3,031,308,000	(1)	28,901,887
Pyrites	65,878	331,484	96,445	486,558	(1)	3,031,308,000	(1)	28,901,887
Salt (sodium chloride)	590,770	6,360,223	466,890	4,870,287	(1)	3,031,308,000	(1)	28,901,887
Sand and gravel	325,652	3,815,272	331,901	4,097,635	(1)	3,031,308,000	(1)	28,901,887
Glass sand	195,884,490	205,002,019	171,343,901	184,320,034	(1)	3,031,308,000	(1)	28,901,887
Sand (molding, building, etc.) and gravel	3,128,559	50,100,000	2,963,845	47,300,000	(1)	3,031,308,000	(1)	28,901,887
Silica (quartz)	900,764	8,283,104	1,185,707	10,270,009	(1)	3,031,308,000	(1)	28,901,887
Slate	387,963	4,774,076	412,898	5,121,414	(1)	3,031,308,000	(1)	28,901,887
Sodium salts (carbonates and sulfates) (natural)	17,536	4,774,076	14,912	5,244,365	(1)	3,031,308,000	(1)	28,901,887
Stone	3,815,272	3,815,272	3,815,272	3,815,272	(1)	3,031,308,000	(1)	28,901,887
Sulfur	205,002,019	205,002,019	171,343,901	184,320,034	(1)	3,031,308,000	(1)	28,901,887
Sulfuric acid (60° Baumé) (byproduct)	50,100,000	50,100,000	47,300,000	47,300,000	(1)	3,031,308,000	(1)	28,901,887
Talc, pyrophyllite, and soapstone	8,283,104	8,283,104	1,185,707	10,270,009	(1)	3,031,308,000	(1)	28,901,887
Tripoli	412,898	4,774,076	14,912	5,244,365	(1)	3,031,308,000	(1)	28,901,887

See footnotes at end of table.

Mineral products of the United States, 1942-44—Continued

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
NONMETALLIC—continued						
Vermiculite.....	57,848	\$319,931	46,645	\$471,595	54,116	\$541,744
Other nonmetallic ^a		4,265,893		4,770,156		4,511,391
Total value of nonmetallic products (approximate).....		5,212,400,000		5,583,000,000		6,112,000,000
SUMMARY						
Total value:						
Metallic.....		2,363,900,000		2,488,000,000		2,340,000,000
Nonmetallic:						
Fuels.....		4,103,400,000		4,608,300,000		5,212,000,000
Other.....		1,109,000,000		974,700,000		900,000,000
Grand total approximate value of mineral products.....		7,576,300,000		8,071,000,000		8,452,000,000

^a In this general statement certain of the figures represent shipments rather than quantity mined, and some of the figures for 1944 are subject to revision. For details see following chapters of this volume.

^b Figures represent antimonial lead produced at primary refineries from both domestic and foreign primary and secondary sources; no figures for value of antimonial lead available. Estimate of value of primary antimony and lead contents of antimonial lead from domestic sources included in total value of metallic products.

^c Largely from foreign ore; value not included in total value.

^d 1942-43: As shipped; 1944: Dried-bauxite equivalent.

^e Product from domestic ores only.

^f Value does not include premiums paid to miners by the Government. Total over-riding payments for copper, lead, and zinc amounted to approximately \$26,000,000 in 1942, \$73,000,000 in 1943, and \$89,000,000 in 1944.

^g According to Bureau of the Mint. Valued at \$35 per ounce.

^h Value not included in total value.

ⁱ Figures not available.

^j Figures showing values not available.

^k Figures included in total value of metallic products; Bureau of Mines not at liberty to publish figures.

^l According to Bureau of the Mint.

^m Includes value of following products. Figures are shown wherever Bureau of Mines is at liberty to publish them.

1943 and 1944: Bismuth, cobalt, germanium, indium, radium, thallium, and zircon.

1943 and 1944: Bismuth, cobalt, germanium, indium, thallium, and zircon.

ⁿ Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

^o Includes brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania.

^p Value included in total value of nonmetallic products; Bureau of Mines not at liberty to publish figures.

^q No canvass. Estimate of value included in total value of nonmetallic products.

^r Figures cover fiscal year ended June 30 of year stated.

^s Sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.

^t Equivalent as K₂O.

^u Figures for soapstone used as dimension stone included in figures for stone.

^v From copper, lead and zinc smelters and zinc roasters.

^w Includes value of following products. Figures are shown wherever Bureau of Mines is at liberty to publish them.

1942: Andalusite, crude apatite, natural sulfonated bitumen, dumortierite, flint lining for tube mills (2,576 short tons, \$49,967), pebbles for grinding (15,437 short tons, \$245,794), silica sand and sandstone (ground) (527,886 short tons, \$3,646,643), strontium minerals (4,041 short tons, \$55,529), sulfur ore (1,590 long tons, \$16,000), and industrial topaz.

1943: Andalusite, crude apatite, natural sulfonated bitumen, calcite (Iceland spar), corundum, dumortierite, flint lining for tube mills (2,385 short tons, \$46,071), pebbles for grinding (9,924 short tons, \$157,778), quartz crystal (5,968 pounds, \$25,598), silica sand and sandstone (ground) (541,350 short tons, \$3,937,452), strontium minerals (7,566 short tons, \$114,526), sulfur ore (2,572 long tons, \$26,215), industrial topaz, and wollastonite.

1944: Andalusite, crude apatite, natural sulfonated bitumen, calcite (Iceland spar) (5,748 pounds, \$57,480), corundum, dumortierite, flint lining for tube mills (2,063 short tons, \$38,839), pebbles for grinding (8,012 short tons, \$172,418), quartz crystal (3,934 pounds, \$23,769), silica sand and sandstone (ground) (538,606 short tons, \$3,989,951), strontium minerals (3,005 short tons, \$48,163), sulfur ore (1,639 long tons, \$8,950), industrial topaz, and wollastonite.

Value of mineral products of the United States, 1880-1944¹

Year	Metallic	Nonmetallic			Grand total
		Fuels ²	Other	Total	
1880 ¹	\$190,881,000	\$120,241,000	\$56,341,000	\$176,582,000	\$367,463,000
1881	192,063,000	149,798,000	60,659,000	210,457,000	403,120,000
1882	219,070,000	170,479,000	63,557,000	234,036,000	453,106,000
1883	201,131,000	185,760,000	61,170,000	246,930,000	448,061,000
1884	182,784,000	165,825,000	58,431,000	224,256,000	407,040,000
1885	174,718,000	153,075,000	61,758,000	214,833,000	419,551,000
1886	204,796,000	184,808,000	66,782,000	251,590,000	456,185,000
1887	241,183,000	217,251,000	77,199,000	294,450,000	535,633,000
1888	242,400,000	231,459,000	79,880,000	311,339,000	553,799,000
1889	250,823,000	208,297,000	83,206,000	291,503,000	542,326,000
1890	303,937,000	230,962,000	80,530,000	311,492,000	615,429,000
1891	290,985,000	237,160,000	82,704,000	319,864,000	600,849,000
1892	284,215,000	248,344,000	89,673,000	338,017,000	622,232,000
1893	223,654,000	251,735,000	70,104,000	321,839,000	545,493,000
1894	187,335,000	235,618,000	127,292,000	362,910,000	550,245,000
1895	248,533,000	268,438,000	125,720,000	394,158,000	642,691,000
1896	282,575,000	268,161,000	120,305,000	388,466,000	641,041,000
1897	270,434,000	268,598,000	127,580,000	396,178,000	651,612,000
1898	308,747,000	253,513,000	150,782,000	418,295,000	727,042,000
1899	484,021,000	267,773,000	185,302,000	453,075,000	1,010,096,000
1900	514,232,000	406,376,000	188,328,000	594,704,000	1,108,936,000
1901	498,814,000	442,409,000	218,855,000	661,264,000	1,155,078,000
1902	605,017,000	469,079,000	253,855,000	722,934,000	1,327,951,000
1903	589,253,000	634,226,000	271,902,000	906,128,000	1,495,381,000
1904	501,314,000	584,043,000	273,824,000	857,867,000	1,359,181,000
1905	702,785,000	602,258,000	318,722,000	920,980,000	1,623,765,000
1906	886,290,000	652,398,000	362,202,000	1,014,600,000	1,900,880,000
1907	904,151,000	759,128,000	376,291,000	1,135,419,000	2,069,570,000
1908	550,890,000	716,034,000	324,849,000	1,040,883,000	1,591,773,000
1909	755,092,000	746,204,000	385,811,000	1,132,015,000	1,887,107,000
1910	750,027,000	828,213,000	409,604,000	1,237,817,000	1,987,844,000
1911	681,023,000	835,763,000	407,295,000	1,243,058,000	1,924,081,000
1912	862,191,000	945,541,000	430,082,000	1,375,603,000	2,237,794,000
1913	870,068,000	1,087,843,000	466,644,000	1,554,487,000	2,433,545,000
1914	876,101,000	992,837,000	431,234,000	1,424,071,000	2,111,172,000
1915	993,363,000	972,617,000	428,674,000	1,401,291,000	2,394,644,000
1916	1,622,129,000	1,332,584,000	553,726,000	1,886,310,000	3,508,439,000
1917	2,088,914,000	2,237,837,000	665,745,000	2,903,582,000	4,992,496,000
1918	2,136,588,000	2,736,151,000	647,969,000	3,384,120,000	5,540,708,000
1919	1,361,099,000	2,510,894,000	751,777,000	3,262,671,000	4,623,770,000
1920	1,763,675,000	4,192,910,000	1,024,755,000	5,217,665,000	6,981,340,000
1921	654,700,000	2,703,470,000	780,330,000	3,483,800,000	4,138,500,000
1922	988,100,000	2,737,880,000	921,310,000	3,659,190,000	4,647,290,000
1923	1,611,980,000	3,317,100,000	1,157,470,000	4,474,570,000	5,986,500,000
1924	1,233,370,000	2,898,630,000	1,173,800,000	4,072,430,000	5,305,800,000
1925	1,282,155,000	3,068,680,000	1,236,795,000	4,295,475,000	5,677,630,000
1926	1,405,345,000	3,541,916,000	1,266,339,000	4,808,255,000	6,213,600,000
1927	1,220,633,000	3,060,047,000	1,249,320,000	4,309,367,000	5,530,000,000
1928	1,288,290,000	2,884,962,000	1,211,948,000	4,096,910,000	5,385,200,000
1929	1,490,390,000	3,190,527,000	1,216,693,000	4,407,210,000	5,897,600,000
1930	1,965,790,000	2,764,500,000	1,014,510,000	3,779,010,000	4,764,800,000
1931	599,790,000	1,892,400,000	704,410,000	2,596,810,000	3,166,600,000
1932	285,875,000	1,743,400,000	432,425,000	2,175,825,000	2,461,700,000
1933	417,065,000	1,683,400,000	454,635,000	2,138,035,000	2,555,100,000
1934	548,934,000	2,233,300,000	543,166,000	2,776,466,000	3,325,400,000
1935	733,130,000	2,330,000,000	586,870,000	2,916,870,000	3,650,000,000
1936	1,081,600,000	2,759,500,000	716,000,000	3,475,200,000	4,556,800,000
1937	1,468,200,000	3,200,500,000	744,700,000	3,945,200,000	5,413,400,000
1938	892,600,000	2,820,300,000	650,300,000	3,470,600,000	4,363,200,000
1939	1,291,700,000	2,834,300,000	788,200,000	3,622,500,000	4,914,200,000
1940	1,678,600,000	3,116,500,000	818,800,000	3,935,300,000	5,613,900,000
1941	2,132,000,000	3,708,100,000	1,037,900,000	4,746,000,000	6,878,000,000
1942	2,363,900,000	4,103,400,000	1,109,000,000	5,212,400,000	7,576,300,000
1943	2,488,000,000	4,608,300,000	974,700,000	5,583,000,000	8,071,000,000
1944 ¹	2,340,000,000	5,212,000,000	900,000,000	6,112,000,000	8,452,000,000
Grand total.....	55,735,027,000	101,537,252,000	32,710,710,000	134,247,962,000	189,982,989,000

¹ Figures for earlier years not available.² Coal, natural gas, natural gasoline and allied products, petroleum.³ Subject to revision.

The sum of the following State totals does not reach the total for the United States given in the preceding table partly because figures for certain of the products included in the United States total are not available by States of origin. This fact is brought out in the opening text of this chapter and in the second table following.

In addition, there are many factors (the more important discussed in the opening text) that account for the disagreement between the sum of the State totals and the grand total for the United States, by products. Chief among these are: (1) The use of iron ore values in State totals and pig iron values in United States total; (2) the use of mine figures for gold, silver, copper, lead, and zinc in the State totals and mint and smelter figures (supplemented by the value of byproduct sulfuric acid from copper, lead, and zinc smelting and zinc roasting and the value of zinc and lead pigments made in large part direct from ores) in the United States total; and (3) the inclusion of estimates in the United States total for a few products for which no canvass has been conducted for many years and for which no estimate by States is made.

Many other less important differences are involved, but both State and United States totals are as complete and definite as seems possible with the data available. The practice is consistent from year to year, and it is believed that the reader can determine readily just what minerals are covered by the total concerned.

In every table each mineral produced is listed, and all figures are shown except those that the Bureau of Mines is not at liberty to publish.

Value of mineral products of the United States, 1940-44, and total, 1911-44, by States

State	1941-44 ¹					Percent of total for United States
	1940	1941	1942	1943	1944	
Alabama.....	\$64,906,018	\$82,730,210	\$100,222,752	\$102,684,000	\$108,460,000	1.43
Alaska.....	28,724,221	20,809,380	20,004,260	9,055,000	7,032,000	.62
Arizona.....	86,291,347	100,470,791	117,690,899	124,684,000	116,600,000	2.26
Arkansas.....	37,479,135	47,081,326	60,337,118	81,249,000	68,423,000	.78
California.....	466,672,038	506,796,386	541,391,005	666,441,000	606,918,000	8.58
Colorado.....	63,198,421	73,960,602	95,276,822	88,634,000	79,698,000	1.48
Connecticut.....	3,914,177	5,284,955	5,054,812	4,835,000	4,496,000	.11
Delaware.....	457,326	492,631	402,273	387,000	182,000	.01
District of Columbia.....	640,480	700,000	600,000	100,000	111,000	.01
Florida.....	14,854,206	19,268,779	20,303,948	26,070,000	21,852,000	.82
Georgia.....	16,932,335	21,049,201	22,048,807	20,927,000	18,965,000	.29
Idaho.....	40,799,920	46,673,740	54,289,536	57,475,000	61,321,000	.75
Illinois.....	277,943,011	320,699,559	327,665,438	322,050,000	331,497,000	4.77
Indiana.....	68,975,110	80,572,397	89,571,417	83,613,000	91,143,000	1.34
Iowa.....	28,006,904	28,872,177	28,273,387	24,187,000	24,458,000	.74
Kansas.....	130,899,806	171,991,683	201,454,022	220,413,000	219,678,000	2.71
Kentucky.....	131,974,410	169,006,196	204,284,166	226,578,000	273,597,000	2.72
Louisiana.....	189,153,312	228,440,044	246,635,691	290,412,000	304,894,000	2.37
Maine.....	4,874,976	4,692,448	8,614,054	2,720,000	2,146,000	.11
Maryland.....	12,605,171	17,291,623	18,383,872	17,606,000	15,399,000	.27
Massachusetts.....	7,572,122	9,283,059	8,467,865	6,441,000	15,890,000	.23
Michigan.....	124,741,851	142,580,772	161,549,722	157,600,000	151,620,000	2.03
Minnesota.....	126,779,647	176,790,974	189,992,728	177,987,000	178,448,000	2.43
Mississippi.....	50,239,566	47,546,042	50,992,628	41,195,000	18,988,000	.12
Missouri.....	70,487,873	98,583,460	96,181,694	92,212,000	72,369,000	1.16
Montana.....	4,692,146	6,499,070	8,528,200	9,714,000	2,444,899,000	1.78
Nevada.....	42,570,529	46,341,010	46,213,273	6,900,000	5,080,000	.10
New Hampshire.....	1,065,337	1,382,508	1,211,184	1,350,000	1,168,000	.06
New Jersey.....	33,653,732	30,074,518	38,921,151	37,683,000	33,794,000	1.15
New Mexico.....	80,909,723	97,840,086	106,811,195	123,805,000	126,230,000	1.73
New York.....	76,119,505	91,582,704	103,298,336	88,416,000	88,015,000	1.23
North Carolina.....	21,112,732	18,915,461	17,372,690	22,172,000	22,199,000	.39
North Dakota.....	2,987,351	3,327,627	4,028,008	4,422,000	4,671,000	.06
Ohio.....	130,655,126	164,826,884	176,548,629	189,422,000	190,937,000	2.36
Oklahoma.....	236,635,062	263,763,923	271,296,469	254,642,000	260,576,000	4.37
Oregon.....	11,220,670	12,830,176	14,065,672	12,267,000	9,668,000	.16

¹ In this table iron ore, not pig iron, is taken as the basis of iron valuation, and for other metals mine production (recoverable content of metals) is the basis. Comparable totals for years before 1911 not available.

Value of mineral products of the United States, 1940-44, and total, 1911-44, by States—Continued

State	1940	1941	1942	1943	1944	1911-44		
						Total value	Rank	Percent of total for United States
Pennsylvania.....	\$618,847,805	\$737,143,530	\$841,847,147	\$889,077,000	\$989,949,000	\$26,083,338,000	1	18.03
Rhode Island.....	994,997	1,133,400	836,040	808,000	612,000	30,381,000	48	.02
South Carolina.....	6,305,597	7,245,613	5,890,982	4,759,000	4,192,000	103,336,000	45	.07
South Dakota.....	23,528,825	24,501,696	24,139,233	8,608,000	5,465,000	419,001,000	35	.30
Tennessee.....	42,683,407	56,301,592	67,223,639	64,485,000	63,382,000	1,208,362,000	26	.87
Texas.....	725,005,009	868,082,690	909,293,296	1,103,390,000	1,319,378,000	14,309,453,000	2	10.29
Utah.....	104,392,989	122,386,873	146,968,512	164,150,000	150,153,000	2,710,359,000	14	1.96
Vermont.....	6,979,772	8,131,670	7,296,089	6,404,000	7,672,000	323,937,000	88	.22
Virginia.....	50,003,672	71,340,934	79,770,810	85,825,000	88,628,000	1,331,882,000	24	.96
Washington.....	28,090,188	28,506,882	35,659,543	37,993,000	36,320,000	716,166,000	31	.61
West Virginia.....	329,891,900	425,626,303	493,994,630	564,230,000	612,366,000	10,344,866,000	4	7.44
Wisconsin.....	13,533,683	17,020,722	17,998,086	18,930,000	22,794,000	649,616,000	82	.39
Wyoming.....	43,073,533	52,761,354	64,070,497	70,737,000	73,031,000	1,602,108,000	22	1.08

Mineral products of the United States and principal producing States in 1947

Rank in value	Product	Principal producing States ¹	
		In order of quantity	In order of value
8	Aluminum.....	New York, Washington, Tennessee, Arkansas, California.....	Rank same as for quantity.
(9)	Andalusite.....	Not separable by States.....	Do.
63	Antimonial lead.....	Idaho, Oregon, Alaska, Nevada.....	Not separable by States.
64	Antimony.....	Idaho, Oregon, Alaska, Nevada.....	Idaho, Alaska, Oregon, Nevada.
58	Arsenic oxide.....	Vermont, Utah.....	Rank same as for quantity.
76	Asbestos.....	Vermont, North Carolina, Arizona, California.....	Do.
46	Asphalt.....	Texas, Oklahoma, Kentucky, Utah.....	Arizona, Vermont, North Carolina, California.
56	Barite.....	Not separable by States.....	Utah, Texas, Kentucky, Oklahoma.
54	Barite (crude).....	Missouri, Georgia, Arkansas, Tennessee.....	Not separable by States.
24	Bauxite.....	Arkansas, Alabama, Georgia, Virginia.....	Missouri, Arkansas, Georgia, Tennessee.
60	Beryllium ore.....	South Dakota, Colorado, New Hampshire, New Mexico.....	Rank same as for quantity.
60	Bismuth.....	Not separable by States.....	Do.
100	Bitumen (natural sulfonated).....	Utah.....	Not separable by States.
39	Bitumen minerals.....	California.....	Rank same as for quantity.
30	Bromine.....	North Carolina, Texas, Michigan, California.....	Do.
38	Cadmium.....	Not separable by States.....	Not separable by States.
87	Calcite (celand spar).....	California, Montana.....	Rank same as for quantity.
57	Calcium-magnesium chloride.....	Michigan, West Virginia, California, Ohio.....	Michigan, California, West Virginia, Ohio.
10	Cement.....	Pennsylvania, California, Texas, Alabama.....	Rank same as for quantity.
44	Chromite.....	Montana, California, Oregon, Alaska.....	California, Montana, Oregon, Alaska.
16	Clay.....	Pennsylvania, Missouri, Ohio, Georgia.....	Ohio, Pennsylvania, Illinois, New Jersey.
	Products (other than pottery and refractories).....		Georgia, Pennsylvania, Missouri, Kentucky.
28	Raw (sold or shipped by producers).....	West Virginia, Pennsylvania, Illinois, Kentucky.....	West Virginia, Pennsylvania, Kentucky, Illinois.
1	Coal.....	Pennsylvania.....	Rank same as for quantity.
68	Cobalt.....	Pennsylvania, Ohio, Indiana, Alabama.....	Do.
5	Coke.....	Arizona, Utah, Montana, New Mexico.....	Pennsylvania, Indiana, Ohio, New York.
9	Copper.....	South Carolina.....	Rank same as for quantity.
106	Corundum.....	California, Oregon, Nevada, Washington.....	Do.
52	Diatomite.....	New York.....	Do.
99	Dumortierite.....	North Carolina, South Dakota, New Hampshire, Colorado.....	Do.
90	Emerald.....	Pennsylvania, New York, Ohio, West Virginia.....	North Carolina, South Dakota, New Hampshire, Virginia.
56	Feldspar (crude).....	Minnesota, North Carolina, Wisconsin.....	Pennsylvania, New York, West Virginia, Ohio.
6	Ferro-alloys.....	Illinois, Kentucky, Colorado, New Mexico.....	Rank same as for quantity.
93	Flint lining for tube mills.....	Texas, Georgia, Illinois, Florida.....	Do.
33	Fluorspar.....	New York, Idaho, North Carolina.....	Georgia, Texas, Florida, Illinois.
55	Fuller's earth.....	No canvass for 1943.....	Rank same as for quantity.
73	Garnet (abrasive).....	Not separable by States.....	No canvass for 1943.
(1)	Gems and precious stones.....		Not separable by States.
104	Germanium.....		

See footnotes at end of table.

Mineral products of the United States and principal producing States in 1943—Continued

Rank in value	Product	Principal producing States	
		In order of quantity	In order of value
20	Gold.....	Utah, Arizona, California, Nevada.....	Rank same as for quantity.
64	Graphite:		
	Amorphous.....	Rhode Island, Nevada.....	Do.
	Crystalline.....	Alabama, Texas, Pennsylvania, Montana.....	Do.
71	Grindstones and pulpstones.....	Ohio, West Virginia, Washington.....	Do.
41	Gypsum (crude).....	New York, Michigan, California, Iowa.....	New York, Michigan, Nevada, California.
77	Helium.....	Texas.....	Rank same as for quantity.
74	Iridium.....	Not separable by States.....	Not separable by States.
65	Iodine (natural).....	California.....	Rank same as for quantity.
	Iron:		
7	Ore.....	Minnesota, Michigan, Alabama, Wisconsin.....	Minnesota, Michigan, Alabama, New York.
3	Pig.....	Pennsylvania, Ohio, Indiana, Illinois.....	Rank same as for quantity.
81	Kyanite.....	Virginia, North Carolina, Georgia, California.....	Virginia, North Carolina, California, Georgia.
18	Lead.....	Missouri, Idaho, Utah, Oklahoma, West Virginia.....	Rank same as for quantity.
19	Lime.....	Ohio, Pennsylvania, Missouri, California, New Mexico.....	Do.
78	Lithium minerals.....	South Dakota, North Carolina, California, Texas.....	Do.
40	Magnesite (crude).....	Washington, Nevada, California, Texas.....	Nevada, Washington, California, Texas.
17	Magnesium.....	Texas, Nevada, Ohio, Michigan, Nevada.....	Rank same as for quantity.
29	Magnesium compounds (natural).....	Texas, Michigan, California, Nevada, Washington.....	Texas, California, Michigan, New Jersey.
37	Manganese ore.....	Montana, California, Nevada, Washington.....	Montana, California, Washington, Virginia.
45	Manganiferous ore.....	Minnesota, Michigan, New Mexico, Virginia.....	Rank same as for quantity.
62	Manganiferous zinc residuum.....	New Jersey.....	Do.
	Marl:		
85	Calcareous.....	Virginia, Minnesota, Michigan, Indiana.....	Virginia, West Virginia, Minnesota, Nevada.
69	Greensand.....	New Jersey.....	Rank same as for quantity.
35	Mercury.....	California, Oregon, Nevada, Idaho.....	Do.
48	Mica.....	North Carolina, Georgia, California, Colorado.....	North Carolina, New Hampshire, South Dakota, Georgia.
	Scrap.....	do.....	North Carolina, South Dakota, Georgia, Virginia.
	Sheet.....	North Carolina, New Hampshire, South Dakota, Georgia.....	Rank same as for quantity.
101	Millstones.....	do.....	Virginia, North Carolina, New York.
	Mineral pigments:		
36	Natural pigments and manufactured iron oxide pigments.....	Pennsylvania, Illinois, New Jersey, Virginia.....	Pennsylvania, New Jersey, Illinois, California.
26	Lead and zinc pigments.....	Pennsylvania, Illinois, Kansas, Ohio.....	Pennsylvania, Illinois, Ohio, Kansas.
(3)	Mineral waters.....	No canvass for 1943.....	No canvass for 1943.
23	Molybdenum.....	Colorado, Utah, New Mexico, California.....	Rank same as for quantity.
4	Natural gas.....	Texas, Louisiana, California, Oklahoma.....	Texas, California, West Virginia, Louisiana.
13	Natural gasoline and allied products:		
	Natural gasoline and cycle products.....	Texas, California, Oklahoma, Louisiana.....	Rank same as for quantity.
	Liquefied petroleum gases.....	Texas, Illinois, Oklahoma, California.....	Texas, California, Illinois, Oklahoma.
79	Nickel.....	Not separable by States.....	Not separable by States.
83	Oilstones, etc.....	Arkansas, New Hampshire, Ohio, Indiana.....	Arkansas, Ohio, New Hampshire, Indiana.
92	Olivine.....	North Carolina.....	Rank same as for quantity.

70	Peat.....	Arizona, Utah, Nevada, New Mexico, New Jersey, Maine, Minnesota.
84	Pebbles for grinding.....	Rank same as for quantity.
81	Petroleum.....	Do.
32	Phosphate rock.....	Florida, Tennessee, Idaho, Montana.
61	Platinum metals.....	Rank same as for quantity.
27	Potassium salts.....	Do.
66	Pumice.....	Do.
53	Pyrites.....	Do.
97	Quartz crystal.....	New Mexico, Kansas, California, Nebraska.
22	Salt.....	Tennessee, Virginia, California, New York.
12	Sand and gravel.....	Arkansas, California, North Carolina, Virginia.
59	Selenium.....	Michigan, New York, Kansas, Ohio.
75	Silica (quartz).....	California, Ohio, Illinois, Pennsylvania.
49	Silica sand and sandstone (ground).....	Not separable by States.
25	Silver.....	Washington, California, North Carolina, Wisconsin.
43	Slate.....	Illinois, Ohio, New Jersey, Pennsylvania.
47	Sodium salts (carbonates and sulfates) (natural).....	Rank same as for quantity.
11	Stone.....	Pennsylvania, Vermont, New York, Maine.
86	Strontium minerals.....	Rank same as for quantity.
21	Sulfur.....	Do.
34	Sulfuric acid from copper, lead, and zinc smelters and zinc roasters.....	Pennsylvania, Illinois, Tennessee, Indiana.
96	Sulfur ore.....	Rank same as for quantity.
42	Talc, pyrophyllite, and ground soapstone.....	New York, California, Vermont, North Carolina.
95	Tantalum and columbium ores.....	New Mexico, Colorado, South Dakota, North Carolina.
88	Tenarum.....	Not separable by States.
91	Thallium.....	Do.
103	Tin.....	Rank same as for quantity.
100	Tinanium concentrates.....	Do.
50	Uranite.....	Do.
67	Uranium.....	Do.
98	Uranium (industrial).....	Do.
80	Vanadium.....	Do.
32	Vanadium ore.....	Do.
51	Vermiculite.....	Do.
72	Wollastonite.....	Do.
105	Zinc.....	Do.
14	Zinc.....	Oklahoma, Idaho, New Jersey, New Mexico.
102	Zircon.....	Rank same as for quantity.

¹ Rank of States in metal production (except aluminum, ferro-alloys, and pig iron) arranged according to mine reports, not smelter output. Compilation of rank for 1944 not yet available.

² Separate figures for antimonial lead from primary sources not available.

2 Separate figures for anthracite and bituminous coal from primary sources not available.
 3 No canvass for 1943.
 4 Value not available.
 5 Exclusive of soapstone used as dimension stone (all from Virginia), which is included in figures for stone.

³ No canvass for 1943.

States and their principal mineral products in 1943¹

State	Rank	Percent of total value for United States	Principal mineral products in order of value
Alabama.....	16	1.55	Coal, iron ore, cement, stone.
Alaska.....	38	.14	Gold, sand and gravel, coal, platinum metals.
Arizona.....	14	1.89	Copper, gold, zinc, silver.
Arkansas.....	22	1.23	Bauxite, petroleum, coal, natural gas.
California.....	3	8.87	Petroleum, natural gas, natural gasoline, cement.
Colorado.....	18	1.34	Molybdenum, coal, zinc, gold.
Connecticut.....	43	.07	Magnesium, stone, clay products, sand and gravel.
Delaware.....	49	.01	Clay products, sand and gravel, stone, raw clay.
District of Columbia.....	50	(²)	Clay products.
Florida.....	30	.38	Phosphate rock, stone, cement, sand and gravel.
Georgia.....	34	.32	Raw clay, stone, cement, clay products.
Idaho.....	26	.87	Zinc, lead, silver, tungsten ore.
Illinois.....	5	4.88	Coal, petroleum, stone, sand and gravel.
Indiana.....	21	1.27	Coal, cement, petroleum, stone.
Iowa.....	31	.37	Coal, cement, stone, clay products.
Kansas.....	9	3.34	Petroleum, natural gas, zinc, coal.
Kentucky.....	8	3.59	Coal, natural gas, petroleum, stone.
Louisiana.....	6	4.08	Petroleum, natural gas, natural gasoline, sulfur.
Maine.....	46	.04	Sand and gravel, cement, stone, slate.
Maryland.....	36	.26	Coal, sand and gravel, cement, stone.
Massachusetts.....	42	.08	Stone, sand and gravel, lime, clay products.
Michigan.....	13	2.38	Iron ore, petroleum, salt, natural gas.
Minnesota.....	11	2.60	Iron ore, manganese ore, sand and gravel, stone.
Mississippi.....	33	.32	Petroleum, sand and gravel, clay products, raw clay.
Missouri.....	23	1.09	Lead, coal, cement, zinc.
Montana.....	17	1.39	Copper, petroleum, coal, zinc.
Nebraska.....	40	.10	Cement, sand and gravel, stone, petroleum.
Nevada.....	27	.86	Copper, magnesium, gold, tungsten ore.
New Hampshire.....	47	.02	Mica, feldspar, clay products, stone.
New Jersey.....	29	.57	Zinc, sand and gravel, clay products, stone.
New Mexico.....	15	1.88	Petroleum, potassium salts, copper, natural gas.
New York.....	19	1.34	Petroleum, iron ore, zinc, salt.
North Carolina.....	32	.34	Bromine, stone, clay products, mica.
North Dakota.....	45	.07	Coal, sand and gravel, natural gas, clay products.
Ohio.....	10	2.87	Coal, natural gas, stone, clay products.
Oklahoma.....	7	3.86	Petroleum, natural gas, zinc, natural gasoline.
Oregon.....	37	.19	Sand and gravel, cement, stone, mercury.
Pennsylvania.....	2	13.47	Coal, petroleum, natural gas, cement.
Rhode Island.....	48	.01	Stone, sand and gravel, graphite, clay products.
South Carolina.....	44	.07	Stone, clay products, raw clay, sand and gravel.
South Dakota.....	39	.13	Gold, stone, raw clay, cement.
Tennessee.....	25	.98	Coal, stone, zinc, cement.
Texas.....	1	16.72	Petroleum, natural gas, natural gasoline, sulfur.
Utah.....	12	2.49	Copper, coal, gold, zinc.
Vermont.....	41	.10	Stone, slate, talc, lime.
Virginia.....	20	1.30	Coal, stone, sand and gravel, zinc.
Washington.....	28	.57	Cement, sand and gravel, coal, magnesite.
West Virginia.....	4	8.55	Coal, natural gas, petroleum, natural gasoline.
Wisconsin.....	35	.29	Stone, iron ore, zinc, sand and gravel.
Wyoming.....	24	1.07	Petroleum, coal, natural gas, iron ore.

¹ In this table iron ore, not pig iron, is taken as the basis of iron valuation, and for other metals mine production (recoverable content of metals) is the basis. Compilation of rank for 1944 not yet available.

² Less than 0.01 percent.

Prices of gold, silver, copper, lead, and zinc, 1932-44¹

Year	Gold ²	Silver ³	Copper ⁴	Lead ⁴	Zinc ⁴
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1932.....	\$20.67+	\$0.282	\$0.063	\$0.030	\$0.030
1933.....	25.56	.350	.064	.037	.042
1934.....	34.95	.646+	.080	.037	.043
1935.....	35.00	.71875	.083	.040	.044
1936.....	35.00	.7745	.092	.046	.050
1937.....	35.00	.7735	.121	.059	.065
1938.....	35.00	.646+	.098	.046	.048
1939.....	35.00	.7678+	.104	.047	.052
1940.....	35.00	.711+	.113	.050	.063
1941.....	35.00	.711+	.118	.057	.075
1942.....	35.00	.711+	.121	.067	.093
1943.....	35.00	.711+	.130	.075	.108
1944.....	35.00	.711+	.135	.080	.114

¹ Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was \$20.67+ per fine ounce. For table of prices for silver, copper, lead, and zinc from 1850 to 1931, by years, see Mineral Resources, 1931, pt. 1, p. A115.

² 1932: Legal coinage value; 1933-34: Yearly average weighted Government price; 1935-44: Price under authority of Gold Reserve Act of January 31, 1934.

³ 1932-33: Average New York price for bar silver; 1934 and 1938-44: Treasury buying price for newly mined silver; 1935-37: Yearly average weighted Treasury buying price for newly mined silver.

⁴ Yearly average weighted price of all grades of primary metal sold by producers. Beginning 1942, price includes premiums paid to miners by the Government.

² \$20.671835.

³ \$0.646464.

⁴ \$0.678787.

⁵ \$0.71111111.

STATE TABLES
Mineral products of the United States, 1943-44, by States
ALABAMA

Product	1942			1943			1944		
	Quantity	Value		Quantity	Value		Quantity	Value	
Aluminum.....	(1) ²	(1) ³		(1) ²	(1) ³		(1) ²	(1) ³	
Asphalt (native).....	(1)	(1)		(1)	(1)		(1)	(1)	
Barite.....	(1)	(1)		(1)	(1)		(1)	(1)	
Bauxite.....	(1)	(1)		(1)	(1)		(1)	(1)	
Cement.....	(1)	(1)		(1)	(1)		(1)	(1)	
Clay.....	8,598,332	\$12,874,701		7,368,567	\$10,943,926		4,553,664	\$8,777,741	
Products (other than pottery and refractories)									
Raw (sold or shipped by producers)									
Coal.....	194,452	\$2,000,000		185,442	\$1,500,000		155,717	\$1,970,000	
Coke.....	19,301,254	219,953		17,160,320	239,800		18,997,000	73,701,000	
do.....	5,674,939	55,408,117		5,351,129	59,145,788		5,727,612	\$2,037,495	
Ferro-alloys.....	98,494	\$20,900,850		92,553	\$23,006,369		128,729	\$11,009,967	
Gold.....	1	\$9,174,180		(1)	\$9,340,169		(1)	(1)	
Graphite, crystalline.....	(1)	(1)		(1)	(1)		(1)	(1)	
Iron:									
Ore.....	8,845,146	19,034,753		8,090,473	21,047,221		6,808,111	17,684,154	
Pig.....	4,383,330	\$70,638,989		3,811,987	\$66,151,438		3,696,471	\$68,239,438	
Lime.....	330,352	1,916,985		331,182	1,939,266		333,414	2,004,391	
Manganese ore.....	26	(1)		(1)	(1)		(1)	(1)	
Manganiferous ore.....	308	(1)		(1)	(1)		(1)	(1)	
Mica.....	(1)	(1)		(1)	(1)		(1)	(1)	
Scrap.....	(1)	(1)		77	1,108		63	1,036	
Sheet.....	(1)	(1)		12,750	22,507		1,387	7,173	
Mineral waters.....	(1)	(1)		(1)	(1)		(1)	(1)	
Ore (dry and siliceous) (gold and silver)	(1)	(1)		(1)	(1)		(1)	(1)	
Pebbles for grinding.....	35	(1)		(1)	(1)		(1)	(1)	
Petroleum.....	(1)	(1)		(1)	(1)		(1)	(1)	
Quartz crystal.....	4,659,624	2,538,738		(1)	(1)		43,000	(1)	
Sand and gravel.....	3,141,300	3,738,902		3,704,777	2,029,186		2,019,272	1,172,969	
Stone.....	(1)	(1)		2,568,520	3,178,908		2,542,210	3,355,801	
Talc.....	(1)	(1)		(1)	(1)		(1)	(1)	
Tin (metallic equivalent)	(1)	(1)		(1)	(1)		(1)	(1)	
Miscellaneous ¹	11,639,958	11,639,958		17,427,758	17,427,758		16,573,667	16,573,667	
Total value, eliminating duplications		100,222,752			102,584,000			108,460,000	

¹ No canvass.
² Value included under "Miscellaneous."
³ Value not included in total value for State.
⁴ Exclusive of puzzolan, value for which is included under "Miscellaneous."
⁵ Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
⁶ Figures not available.
⁷ Includes minerals indicated by "1" and "9" above.

Mineral products of the United States, 1942-44, by States—Continued

ALASKA

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Antimony ore (concentrates).....	(1)	(1)	405	\$33,324	73	\$6,465
Arsenic.....	(2)	(2)			(2)	(2)
Asbestos.....						
Chromite.....						
Coal.....	260,893	\$1,623,264	5,569	186,251	1,845	64,456
Copper.....	44,000	5,324	289,232	1,842,708	352,000	2,369,000
Gold.....	487,621	17,066,735	54,000	7,020	4,000	540
Lead.....	415	55,610	99,583	3,485,405	49,296	1,725,360
Mercury.....			200	30,000	44	7,040
Ores (crude), etc.:	(1)	(1)	786	153,435	(1)	(1)
Copper.....			8	(3)		
Dry and siliceous (gold and silver).....	2,816,068	(2)	1,483,519	(3)	381,374	(2)
Platinum metals (crude).....	22,000	1,010,000	27,100	(1)	33,616	(1)
Sand and gravel.....	(1)	(1)	(1)	(1)	712,406	499,269
Silver.....	119,704	85,123	42,788	30,427	13,362	9,502
Stone.....			(1)	(1)	(1)	(1)
Tin (metallic equivalent).....	3	3,300	10	70	19	(1)
Tungsten ore (60-percent concentrates).....						
Miscellaneous.....						
Total value, eliminating duplications.....		20,094,260		3,285,923		2,350,309
				9,055,000		7,032,000

* Value included under "Miscellaneous."

* Figures not available.

* Not valued as ore; value of recoverable metal content included under the metals.

* 135 pounds.

* Includes minerals indicated by "1" above.

ARIZONA

Arsenious oxide.....	short tons	(1)	1,742	(1)	\$101,061	(1)	1,459	(1)	\$197,304	(1)	696	(1)	\$158,272
Asbestos.....	do.												
Barite.....	do.												
Bismuth.....	pounds	(1)		(1)									
Clay.....													
Products (other than pottery and refractories).....													
Raw (sold or shipped by producers).....	short tons	(2)		(2)	\$210,000	(2)		(2)	\$200,000	(2)		(2)	
Coal.....	do.		1,373		30,068		11,281		26,711		10,000		26,000
Copper.....	pounds		786,774,000		95,196,664		806,262,000		104,827,060		716,606,000		96,741,810
Feldspar (crude).....	long tons	(1)		(1)		(1)		(1)		(1)		(1)	

Fluorspar.....	(1)	(1)	1,328	(1)	970	31,083
Gems and precious stones.....						9,926,070
Gold.....	233,051	8,577,785	171,810	6,019,360	112,169	
Gold-min (crude).....	(1)	(1)		(1)		
Silver.....	346		301	(1)		
Lead.....	14,772	1,070,448	13,727	2,039,000	16,707	2,673,120
Iron ore.....	59,083	439,817	71,044	300,349	61,001	327,792
Lead.....	2,940	73,579	5,770	140,367	8,610	223,926
Manganese ore.....			498	4,336	320	6,941
Manganese ore.....	701	137,641	541	105,609	548	64,861
Mercury.....	(1)	(1)	3	(1)	(1)	(1)
Mica, sheet.....						924,336
Molybdenum.....						
Ores (copper), etc.:						
Copper.....	32,856,971	(1)	36,022,080	(1)	35,288,865	(1)
Dry and siliceous (gold and silver).....	657,942	(1)	186,185	(1)	129,086	(1)
Lead.....	25,898	(1)	41,006	(1)	27,101	(1)
Lead-copper.....	473	(1)	182	(1)		
Zinc.....	106,400	(1)	3,083	(1)	2,468	(1)
Zinc-copper.....	7,267	(1)	88,883	(1)	96,603	(1)
Zinc-lead.....	265,780	(1)	292,630	(1)	337,940	(1)
Zinc-lead-copper.....		(1)	26,739	(1)	18,578	(1)
Quartz crystal.....						
Sand and gravel.....	1,611,353	1,193,603	855,671	649,006	586,164	342,038
Silica (quartz).....	(1)	(1)	(1)	(1)	(1)	(1)
Silver.....	7,064,467	5,023,621	5,713,889	4,063,210	4,394,039	3,124,650
Stone.....	227,220	219,231	340,200	317,454	116,670	105,662
Sulfuric acid 7.....	(2 3)	(2 3)	(2 3)	(2 3)	(2 3)	(2 3)
Tungsten ore (90-percent concentrates).....	219	(1)	62	99,731	29	42,763
Vanadium.....			226,270	142,772	13,382	10,883
Zinc.....	18,522	3,445,092	19,677	4,250,232	29,077	6,629,556
Miscellaneous 9.....		1,751,294		1,476,873		791,934
Total value, eliminating duplications.....		117,900,899		124,584,000		115,600,000

1 Figures not available.

2 Value included under "Miscellaneous."

3 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

4 No canvass.

5 Not valued as ore; value of recoverable metal content included under the metals.
 6 Exclusive of granite and sandstone, value for which is included under "Miscellaneous."
 7 From copper smelting.
 8 Value not included in total value for State.
 9 Includes minerals indicated by "3" and "4" above.

Mineral products of the United States, 1942-44, by States—Continued
ARKANSAS

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Aluminum.....	(1) ²	(1) ²	(1) ²	(1) ²	(1) ²	(1) ²
Barite.....	(1)	(1)	(1)	(1)	(1)	(1)
Bauxite.....	2,737,315	\$12,029,406	7,264,748	\$31,448,573	3,018,755	\$13,679,027
Cement.....	(1)	(1)	(1)	(1)	(1)	(1)
Clay:.....						
Products (other than pottery and refractories).....						
Coal.....	(1)	\$800,000	(1)	(1)	(1)	\$450,000
Raw (sold or shipped by producers).....	1,985,393	7,551,232	1,717,935	7,181,107	32,727	33,177
Gems and precious stones.....	(1)	(1)	(1)	(1)	1,776,000	8,241,000
Gypsum (crude).....	(1)	(1)	(1)	(1)	(1)	(1)
Iron ore.....	(1)	(1)	(1)	(1)	(1)	(1)
Lead.....	2	268	1	150	76	(1)
Lime.....	(1)	(1)	(1)	(1)	(1)	(1)
Manganese ore.....	4,132	113,678	5,319	183,772	7,109	241,055
Mercury.....	14,067	87,576	8,207	69,902	14,755	134,473
Mineral waters.....	2,392	469,669	1,532	299,062	191	22,607
Natural gas.....	(1)	(1)	(1)	(1)	(1)	(1)
Natural gasoline and allied products:.....	19,456,000	3,027,000	36,469,000	4,926,000	48,000,000	6,336,000
Natural petroleum.....	34,033,000	1,138,000	40,353,000	1,867,000	43,701,000	2,190,000
Liquefied petroleum gases.....	8,644,000	92,000	16,484,000	335,000	31,835,000	800,000
Oilstones and whetstones.....	(1)	(1)	(1)	(1)	(1)	(1)
Ores (crude), etc.:.....						
Lead.....	10	(1)	1	(1)	800	(1)
Zinc.....	4,578	(1)	4,341	(1)	(1)	(1)
Petroleum.....	26,028,000	20,300,000	27,600,000	27,320,000	29,418,000	31,100,000
Quartz crystal.....	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel.....	5,531,867	3,919,212	8,264,986	\$1,115,704	2,665,688	1,805,699
Slate.....	(1)	(1)	(1)	(1)	(1)	6,102
Stone.....	2,033,410	2,152,956	1,462,410	1,368,883	730,310	790,271
Strontium minerals.....	(1)	(1)	(1)	(1)	(1)	(1)
Titanium concentrates.....	(1)	(1)	(1)	(1)	511	82,271
Tripoli.....	(1)	(1)	(1)	(1)	(1)	(1)
Zinc.....	181	33,965	96	20,736	19	4,332
Miscellaneous.....		5,029,455		22,897,865		21,534,026
Total value, eliminating duplications.....		60,337,118		81,249,000		68,423,000

¹ Value included under "Miscellaneous."

² Value not included in total value for State.

³ 1942-43: As shipped; 1944: Dried-bauxite equivalent.

⁴ Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

⁵ Not valued as ore; value of recoverable metal content included under the metals.

⁶ Figures not available.

⁷ "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."

⁸ Includes minerals indicated by "17" and "19" above.

	(1) (1)	(2) (1)	(3) (1)	(4) (1)	(5) (1)	(6) (1)	(7) (1)	(8) (1)
Alumina.....								
Andalusite.....								
Antimony ore (concentrates).....								8872
Arsenic.....								
Arsenious oxide.....								
Asbestos.....								
Asphalt (native).....								
Baryte.....	220,723							6,670,567
Boron minerals.....								
Bromine.....								
Calcite (ice-land spar).....	5,949							119,747
Calcium chloride.....	23,787,808							23,645,000
Cement.....	44,873							1,268,790
Chromite.....								
Clay.....								
Products (other than pottery and refractories)								
Raw (sold or shipped by producers)	579,251							4,500,000
Coke.....								1,464,813
Copper.....								
Diatomite.....	2,116,000							3,434,670
Feldspar (crude).....	(1)							
Ferro-alloys.....	5,080							
Fluorspar.....								
Fuller's earth.....								
Gems and precious stones.....								
Gold.....	847,997							4,108,055
Gypsum (crude).....	426,670							798,882
Iodine.....	(1)							
Iron.....								
Ore.....	92,875							1,844,948
Pig.....								
Kyanite.....	(1)							
Lead.....	5,151							908,120
Lime.....	83,399							1,441,604
Lithium minerals.....								
Magnesite.....								
Magnesium.....								
Magnesium compounds (natural).....	78,968,525							3,218,192
Manganese ore.....	12,968							712,856
Manganese ore.....	29,906							44,015
Mercury.....	3,324							3,320,235
Mica, scrap.....	(1)							
Mineral paints (zinc and lead pigments).....								
Mineral waters.....								
Molybdenum.....								
Natural gas.....	403,968,000							137,800,000
Natural gasoline and allied products.....	545,881,000							632,768,000
Natural gasoline and cycle products.....	87,445,000							138,512,000
Liquefied petroleum gases.....								4,446,000

See footnotes at end of State table.

Mineral products of the United States, 1942-44, by States—Continued
CALIFORNIA—Continued

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Ores (crude), etc.:						
Copper.....	393,944	(⁶)	285,526	(⁶)	556,378	(¹)
Dry and siliceous (gold and silver).....	2,076,551	(⁶)	412,763	(⁶)	135,597	(⁶)
Lead.....	29,857	(⁶)	46,038	(⁶)	39,081	(⁶)
Lead-copper.....	5	(⁶)				
Zinc.....	2,089	(⁶)	8,428	(⁶)	69,204	(⁶)
Zinc-copper.....			3,435	(⁶)	90,059	(⁶)
Zinc-lead.....	752	(⁶)	736	(⁶)	35,634	(⁶)
Pebbles for grinding.....	3,031	\$17,262	3,677	\$21,365	4,041	\$27,895
Petroleum.....	248,326,000	255,800,000	284,188,000	298,400,000	311,723,000	326,100,000
Platinum metals (crude).....	1,200	(¹)	62	(¹)		
Potassium salts.....	74,925	206,424	(¹)	(¹)	(¹)	(¹)
Pumice.....	(¹)	(¹)	25,490	160,441	31,409	245,898
Pyrites.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Quartz crystal.....	546,320	2,494,485	596,015	2,839,560	712,558	3,133,185
Salt (sodium chloride).....	34,791,974	22,067,004	29,025,759	18,548,747	24,228,499	15,171,652
Sand and gravel.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Sand and sandstone (ground).....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Silica (quartz).....	1,450,440	1,091,424	699,075	433,120	778,936	553,910
Silver.....	241,386	2,712,438	257,426	(¹)	288,012	80,959
Sodium salts (carbonates and sulfates) (natural).....	12,288,700	11,031,326	8,231,250	6,956,769	79,909,680	3,566,183
Stone.....	(¹)	(¹)	(¹)	(¹)	(¹)	79,957,362
Strontium minerals.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Sulfur.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Sulfuric acid.....	51,649	678,906	53,003	912,291	65,191	1,054,312
Talc, pyrophyllite, and ground soapstone.....	(¹)	(¹)	(¹)	(¹)	2	1,970
Tin (metallic equivalent).....	3,483	4,978,612	3,871	5,865,960	3,027	4,558,545
Tungsten ore (80-percent concentrates).....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Vermiculite.....	613	114,018	1,856	400,806	8,465	1,927,740
Zinc.....		14,229,210		43,980,494		43,705,290
Miscellaneous.....						
Total value, eliminating duplications.....		541,391,606		565,441,000		695,918,000

† Value included under "Miscellaneous."
 ‡ Value not included in total value for State.
 § Figures not available.
 ¶ Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
 * No canvass.
 † Not valued as ore; value of recoverable metal content included under the metals.
 ‡ Exclusive of iron and manganese in 1942 and of marble in 1944, value for which is included under "Miscellaneous."
 § From smelting.
 ¶ Includes minerals indicated by "†" and "¶" above.

Arsenious oxide.....	short tons.	(1)	3	(1)	400,000	(1)	68	(1)	38,348	(1)	35	(1)	45,125
Beryllium ore.....	do.	(1)		(1)	240,824	(1)		(1)	176,007	(1)		(1)	
Bismuth.....	pounds.	(1)		(1)	23,163,270	(1)		(1)	27,511,918	(1)		(1)	
Cement.....	barrels.	(1)		(1)	(2)			(1)	77,710	(1)		(1)	
Clay.....	do.	(1)		(1)	(2)			(1)	8,110,000	(1)		(1)	
Products (other than pottery and refractories).													
Raw (sold or shipped by producers).....													
Coal.....	short tons.	133,798			3 \$1,400,000				\$ 700,000				\$ 000,000
Coke.....	do.	8,085,680			240,824				176,007				152,509
Copper.....	do.	763,656			23,163,270				27,511,918				23,791,000
Feldspar (crude).....	pounds.	2,394,000			(2)				732,105				(2)
Ferro-alloys.....	long tons.	33,610			295,684				257,280				252,960
Fluorspar.....	short tons.	(2)			135,569				88,691				81,967
Fuller's earth.....	do.	31,743			(2)				(2)				
Gems and precious stones.....	do.	(2)			640,938				1,164,868				1,601,043
Gold.....	short tons.	298,627			9,401,945				4,814,530				3,900,925
Gypsum (crude).....	do.	(2)			(2)				(2)				(2)
Iron.....	do.												
Ore.....	long tons.	(2)			(2)				(2)				(2)
Pig.....	do.	15,181			2,034,254				2,704,800				2,881,680
Lead.....	short tons.	(2)			(2)				(2)				(2)
Lime.....	do.								747,270				
Lithium minerals.....	do.								17,698				
Manganese ore.....	do.	513			(2)				(2)				8,000
Manganiferous ore.....	do.	44			(2)				25,688				
Mica.....	do.												
Scrap.....	do.	3,923			30,641				29,801				40,846
Sheet.....	pounds.	(2)			(2)				29				(2)
Mineral waters.....	gallons sold.	48,294,878			(2)				27,705,730				(2)
Molybdenum.....	pounds.	4,865,000			1,095,000				1,425,000				1,327,000
Natural gas.....	M cubic feet.	346,000			17,000				25,000				18,000
Natural gasoline.....	gallons.												
Ores (crude), etc.:.....													
Copper.....	short tons.	203			(2)				(2)				(2)
Dry and siliceous (gold and silver).....	do.	1,212,986			(2)				(2)				(2)
Lead.....	do.	6,418			(2)				(2)				(2)
Lead-copper.....	do.	22			(2)				(2)				(2)
Zinc.....	do.	590			(2)				(2)				(2)
Zinc-lead.....	do.	577,162			(2)				(2)				(2)
Petroleum.....	barrels.	2,196,000			2,440,000				2,620,000				3,380,000
Pyrites.....	long tons.	11,067			31,803				105,473				(2)
Quartz crystal.....	pounds.	(2)			(2)				(2)				(2)
Salt.....	short tons.	4,631,942			3,220,705				915,664				1,518,718
Sand and gravel.....	do.	3,096,211			2,201,750				1,884,501				1,599,830
Silver.....	short tons.	7,951,510			7,735,994				692,904				698,095

See footnotes at end of State table.

Mineral products of the United States, 1942-44, by States—Continued
COLORADO—Continued

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Sulfur ore.....long tons.....	90	\$1,000	(*)	(*)	89	\$1,200
Tantalum and columbium ores.....pounds.....	376	562,403	2,225	\$2,307	296	433,303
Tungsten ore (60-percent concentrates).....short tons.....	3,071,330	(*)	4,159,830	2,610,207	3,058,727	1,288,326
Vanadium.....pounds.....	2,574	25,996	356	2,529	1,189	11,890
Vermiculite.....short tons.....	32,215	5,991,990	44,094	9,524,304	39,955	9,109,740
Zinc.....do.....		57,035,844		21,915,563		40,868,418
Miscellaneous ¹						
Total value, eliminating duplications.....		95,278,822		88,534,000		79,598,000

¹ Figures not available.

² Value included under "Miscellaneous."

³ Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

⁴ Value not included in total value for State.

⁵ No canvass.

⁶ Not valued as ore; value of recoverable metal content included under the metals.

⁷ Exclusive of dimension basalt, value for which is included under "Miscellaneous."

⁸ Includes minerals indicated by "i," and "j" above.

CONNECTICUT

Beryllium ore.....short tons.....					(*)	(*)	\$700,000
Clay: Products (other than pottery and refractories).....							
Raw (sold or shipped by producers).....	(*)	\$1,300,000					
Coke.....short tons.....	(*)	(*)	(*)	(*)	(*)	(*)	(*)
Feldspar (crude).....long tons.....	12,807	92,076	11,618	76,463	11,390	75,394	
Lime.....short tons.....	(*)	(*)	(*)	(*)	(*)	(*)	(*)
Magnetite.....do.....	(*)	(*)	(*)	(*)	(*)	(*)	(*)
Mica: Scrap.....do.....	200	4,443	304	6,795	593	13,798	
Sheet.....pounds.....	221,483	30,801	202,142	65,239	77,076	147,129	
Mineral waters.....gallons sold.....	(*)	(*)	(*)	(*)	(*)	(*)	(*)
Peat.....short tons.....	(*)	(*)	(*)	(*)	(*)	(*)	(*)
Sand and gravel.....do.....	2,960,477	1,610,583	1,729,052	837,069	1,587,268	784,572	
Stone.....do.....	1,692,399	1,692,399	1,184,950	1,392,215	1,029,790	1,213,543	
Miscellaneous ¹ do.....	1,596,350	4,593,517		6,081,856		4,868,030	
Total value, eliminating duplications.....		5,054,812		4,835,000		4,496,000	

¹ Value included under "Miscellaneous."

² Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

³ Value not included in total value for State.

⁴ No canvass.

⁵ Includes minerals indicated by "i" above.

UPLAWA II

	(1)	\$200,000 (1)	(2)	\$200,000 (1)	\$200,000 (1)
Clay:					
Products (other than pottery and refractories).....					
Raw (sold or shipped by producers).....	100,267	63,298	180,923	69,409	88,443
do.....					
do.....					
Sand and gravel.....	(1)	(1)	(2)	(1)	9,970
Stone.....					
Miscellaneous.....		106,975		67,401	
Total value, eliminating duplications.....		402,273		307,000	182,000

¹ Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering "Value included under 'Miscellaneous,' certain classes of clay products."

DISTRICT OF COLUMBIA

	(1)	(2)	(3)	(4)
Clay products (other than pottery and refractories)			\$600,000	
Miscellaneous				\$111,000
Total value, eliminating duplications.....			600,000	111,000

¹ Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

FLORIDA

	(t)	(c)	(t)	(c)	(t)	(c)	(t)	(c)
Cement.....								
Clay.....			\$ 170,000	(t)				(t)
Products (other than pottery and refractories).....				(t)			\$ 150,000	(t)
Raw (sold or shipped by producers).....				(t)				(t)
Diatomite.....				(t)				(t)
Fuller's earth.....				(t)				(t)
Mine.....			212,291	(t)				(t)
Mineral waters.....				(t)				(t)
Peat.....				(t)				(t)
Sand.....				(t)				(t)
Shale.....				(t)				(t)
Slates.....				(t)				(t)
Stones.....				(t)				(t)
Titanium concentrates.....				(t)				(t)
Uranium.....				(t)				(t)
Rutile.....				(t)				(t)
Zircon.....				(t)				(t)
Miscellaneous *.....				(t)				(t)
Total value, eliminating duplications.....			20,303,948				25,070,000	

1 Value included under "Miscellaneous."

¹ Value included under "Miscellaneous."
² Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

“Commercial.” Value of “Government-and-contractor”¹ stone.
² Exclusive of dimension unclassified stone in 1943 and 1944.
³ Value for which is included under “Miscellaneous.”
⁴ Includes minerals indicated by “1,” “4,” and “10,” above.

Value of "Government-and-contractor" included under "Miscellaneous,"

Mineral products of the United States, 1942-44, by States—Continued
GEORGIA

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Asbestos.....	(1)	(1)	(1)	(1)	(1)	(1)
Barite.....	86,636	\$483,261	98,680	\$621,193	108,851	\$929,090
Bauxite.....	(1)	(1)	(1)	(1)	(1)	(1)
Clay.....	(1)	(1)	(1)	(1)	(1)	(1)
Clay.....barrels	(1)	(1)	(1)	(1)	(1)	(1)
Products (other than pottery and refractories)						
Raw (sold or shipped by producers).....						
Coal.....	803,710	\$2,000,000	771,862	\$2,000,000	704,642	\$2,000,000
Fuller's earth.....	30,913	6,190,284	14,385	6,276,935	21,000	6,854,021
Gems and precious stones.....	(1)	(1)	(1)	(1)	(1)	(1)
Gold.....	30	1,050	12	420	5	175
Iron ore.....	298,370	722,013	413,459	950,211	285,523	687,494
Kyanite.....	(1)	(1)	(1)	(1)	(1)	(1)
Lime.....	10,824	68,323	8,513	59,514	6,079	45,315
Magnesium sulfate (natural).....	4,917	99,505	2,489	(1)	1,135	(1)
Manganese ore.....	10,514	99,127	5,835	64,658	2,232	25,762
Mica.....	(1)	(1)	(1)	(1)	(1)	(1)
Scrap.....	3,643	20,996	6,251	39,336	5,305	107,135
Sheet.....	109,787	44,527	212,554	195,822	60,112	119,342
Mineral waters.....	(1)	(1)	(1)	(1)	(1)	(1)
Ore (dry and siliceous) (gold and silver).....	75	(1)	(1)	(1)	(1)	(1)
Peat.....	(1)	(1)	(1)	(1)	(1)	(1)
Quartz crystal.....	969,934	\$732,528	655,335	\$467,440	569,908	\$416,871
Sand and gravel.....	300	3,008	3,252	32,525	3,090	19,823
Sand and sandstone (ground).....	7	(1)	(1)	(1)	(1)	(1)
Silver.....	3,623,160	\$6,620,633	2,178,510	\$5,373,879	1,773,150	\$5,037,596
Slate.....	29,930	464,160	35,210	396,031	30,425	363,342
Stone.....	(1)	(1)	(1)	(1)	(1)	(1)
Talc.....	(1)	(1)	(1)	(1)	(1)	(1)
Miscellaneous.....	(1)	(1)	(1)	(1)	(1)	(1)
Total value, eliminating duplications.....		22,068,807		20,927,000		18,965,000

1 Value included under "Miscellaneous."

2 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

3 No canvass.

4 Not valued as ore; value of recoverable metal content included under the metals.

5 Figures not available.

6 "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."

7 Exclusive of unclassified stone, value for which is included under "Miscellaneous."

8 Includes minerals indicated by "i," "q," and "r" above.

IDAHO

Antimony ore (concentrates).....	short tons.....	0, 225	8440, 811	15, 038	\$802, 214	12, 133	8532, 906
Arsenious oxide.....	do.....	(1)	(1)	(1)	(1)	(1)	(1)
Bismuth.....	pounds.....	(1)	(1)	(1)	(1)	(1)	(1)
Cement.....	barrels.....	(1)	(1)	(1)	(1)	(1)	(1)
Chromite.....	short tons.....	25	(1)	(1)	(1)	(1)	(1)
Clay.....	.....						
Products (other than pottery and refractories)	.....						
Raw (sold or shipped by producers)	short tons.....	(1)	\$ 100, 000	(1)	\$ 100, 000	(1)	(1)
Copper.....	short tons.....	(1)	830, 060	(1)	604, 240	(1)	455, 760
Diatomite.....	pounds.....	(1)	(1)	(1)	(1)	(1)	(1)
Garnet.....	short tons.....	(1)	(1)	(1)	(1)	(1)	(1)
Garnet, abrasive.....	do.....	(1)	(1)	(1)	(1)	(1)	(1)
Gems and precious stones.....	.....						
Gold.....	troy ounces.....	95, 020	3, 325, 700	30, 808	1, 078, 280	25, 008	875, 280
Lead.....	short tons.....	113, 909	15, 293, 806	90, 457	14, 488, 550	83, 530	13, 364, 800
Manganese ore.....	do.....	(1)	(1)	36	(1)	(1)	(1)
Mercury.....	flasks (76 pounds).....	(1)	(1)	4, 261	831, 790	(1)	(1)
Mica.....	.....						
Scrap.....	short tons.....	(1)	(1)	(1)	(1)	356	7, 161
Sheet.....	pounds.....	(1)	(1)	5, 136	25, 554	48, 787	247, 149
Ores (crude), etc.:.....	.....						
Copper.....	short tons.....	2, 210	(1)	329	(1)	3, 232	(1)
Dry and siliceous (gold and silver).....	do.....	774, 874	(1)	531, 445	(1)	365, 247	(1)
Lead.....	do.....	313, 317	(1)	237, 122	(1)	252, 944	(1)
Lead-copper.....	do.....	83	(1)	68	(1)	39	(1)
Zinc.....	do.....	20, 561	(1)	44, 382	(1)	128, 982	(1)
Zinc-lead.....	do.....	1, 789, 659	(1)	1, 928, 401	(1)	2, 620, 594	(1)
Phosphate rock.....	long tons.....	114, 079	511, 249	108, 916	561, 630	112, 565	584, 400
Quartz crystal.....	pounds.....	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel.....	short tons.....	3, 118, 681	1, 983, 054	4, 690, 745	4, 276, 960	1, 494, 646	788, 798
Silver.....	troy ounces.....	14, 644, 890	10, 414, 144	11, 700, 180	8, 320, 128	9, 931, 614	7, 062, 481
Stone.....	short tons.....	470, 590	588, 989	91, 330	127, 092	6 323, 000	6 413, 805
Tripoli.....	do.....	(1)	(1)	(1)	(1)	(1)	(1)
Tungsten ore (90-percent concentrates).....	do.....	2, 108	(1)	4, 648	(1)	4, 005	(1)
Vanadium.....	pounds.....	(1)	(1)	(1)	(1)	(1)	(1)
Zinc.....	short tons.....	87, 256	16, 229, 616	86, 707	18, 728, 712	91, 372	20, 832, 816
Miscellaneous ?.....	.....	(1)	4, 596, 107	(1)	7, 480, 981	(1)	6, 155, 499
Total value, eliminating duplications.....	.....		54, 289, 536	*	57, 475, 000		51, 321, 000

* Figures not available.

* Value included under "Miscellaneous."

* Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

* No canvass.

* Not valued as ore; value of recoverable metal content included under the metals.

* Exclusive of granite, value for which is included under "Miscellaneous."

* Includes minerals indicated by "a" and "b" above.

Mineral products of the United States, 1942-44, by States—Continued

ILLINOIS

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement.....	7, 102, 393	\$10, 284, 111		\$6, 957, 889	3, 419, 815	\$5, 325, 796
Clay.....						
Products (other than pottery and refractories).....		1 6, 000, 000		1 4, 500, 000		14, 000, 000
Raw (sold or shipped by producers).....	241, 865	124, 397, 603	204, 860	885, 108	216, 917	344, 181
Coal.....	65, 070, 819	124, 043, 967	72, 631, 270	154, 778, 263	76, 960, 000	171, 021, 000
Coke.....	3, 690, 155	27, 364, 122	3, 626, 457	28, 416, 984	3, 875, 764	34, 074, 422
.....	(2 1)	(2 1)	(2 1)	(2 1)		
Ferro-alloys.....	161, 949	4, 306, 750	198, 789	6, 262, 780	176, 259	5, 954, 991
Fluorspar.....	30, 421	284, 611	39, 500	372, 024	42, 277	390, 346
Fuller's earth.....	5, 871, 808	125, 662, 134	5, 920, 894	126, 910, 265	5, 686, 397	118, 953, 078
Iron, pig.....	2, 344	314, 098	2, 043	306, 450	1, 971	315, 660
Lead.....	314, 078	2, 299, 743	314, 736	2, 386, 554	290, 988	2, 296, 539
Lime.....			(2 1)	(2 1)	(2 1)	(2 1)
.....	(2 1)	(2 1)	(2 1)	(2 1)	(2 1)	(2 1)
Marl, calcareous.....						
Mineral paints (zinc and lead pigments).....						
Mineral waters.....	14, 454, 000	2, 351, 000	18, 120, 000	2, 857, 000	20, 000, 000	3, 100, 000
Natural gas.....						
Natural gasoline and allied products:						
Natural gasoline.....	66, 389, 000	3, 252, 000	71, 737, 000	4, 072, 000	61, 851, 000	3, 870, 000
Liquefied petroleum gases.....	72, 834, 000	2, 000, 000	113, 750, 000	3, 358, 000	133, 018, 000	4, 130, 000
Ores (crude), etc.:						
Lead.....	8	(1)	1	(1)		
Zinc.....	86, 788	(1)	13, 091	(1)	28, 137	(1)
Zinc-lead.....	(1)	(1)	84, 787	(1)	136, 907	(1)
.....			(1)	(1)		
Peat.....	106, 391, 000	144, 800, 000	82, 260, 000	112, 700, 000	77, 413, 000	107, 500, 000
Pyrites.....	13, 562	25, 063	12, 998	23, 966	8, 259	15, 262
Sand and gravel.....	17, 720, 343	11, 532, 848	13, 722, 449	9, 882, 322	12, 317, 626	8, 922, 068
Sand and sandstone (ground).....	158, 853	1, 087, 481	164, 401	1, 180, 469	168, 673	1, 098, 275
Silver.....	104	74	2, 153	1, 531	2, 437	1, 733
Stone.....	14, 056, 050	12, 686, 759	11, 137, 960	10, 762, 707	10, 680, 640	10, 700, 140
Sulfuric acid (90° Baumé) *.....	215, 494	2, 036, 418	259, 302	10, 481, 520	234, 245	2, 328, 395
Tripoli.....	12, 575	203, 390	10, 203	168, 758	12, 031	203, 732
Zinc.....	9, 389	1, 746, 354	5, 851	1, 263, 816	7, 262	1, 655, 736
Miscellaneous †.....		5, 568, 650		4, 919, 248		6, 046, 431
Total value, eliminating duplications.....		327, 665, 438		322, 050, 000		331, 497, 000

* Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

† Value not included in total value for State.

‡ Value included under "Miscellaneous."

4 No canvass.

5 Not valued as ore; value of recoverable metal content included under the metals.

6 From zinc smelting.

7 Includes minerals indicated by "9" above.

	(C)	(C)	(C)	(C)	(C)
Cement.....	171,987	\$4,400,000	68,823	\$82,000,000	\$82,000,000
Clay.....	23,388,061	45,292,030	26,623	52,391,176	52,391,176
Products (other than pottery and refractories).....	7,337,512	\$5,146,043	8,111,910	\$66,250,831	\$66,250,831
Raw (sold or shipped by producers).....	0,446,760	\$142,020,764	6,722,005	\$150,497,468	\$150,497,468
Coal.....	102,757	608,650	(1)	(1)	(1)
Gypsum.....	16,764	(1)	(1)	(1)	(1)
Iron, pig.....	(1)	(1)	(1)	(1)	(1)
Iron, pig.....	(1)	(1)	(1)	(1)	(1)
Lime.....	(1)	(1)	(1)	(1)	(1)
Mari, calcareous.....	(1)	(1)	(1)	(1)	(1)
Mineral paints (zinc and lead pigments).....	1,599,000	888,000	1,460,000	1,142,000	1,142,000
Mineral waters.....	6,743,000	9,100,000	5,283,000	7,130,000	7,130,000
Oil.....	(1)	(1)	(1)	(1)	(1)
Petroleum.....	(1)	(1)	(1)	(1)	(1)
Pyrites.....	(1)	(1)	(1)	(1)	(1)
Rubbing stones, scyrbestones, and whetstones.....	12,715,469	6,009,929	8,062,568	4,555,553	3,985,239
Sand and gravel.....	\$6,460,540	\$7,007,241	\$5,351,940	\$6,570,790	\$6,570,790
Stone.....	(1)	(1)	(1)	(1)	(1)
Sulfuric acid.....	(1)	(1)	(1)	(1)	(1)
Miscellaneous.....	(1)	(1)	(1)	(1)	(1)
Total value, eliminating duplications.....	89,571,417	83,513,000	91,143,000	91,143,000	91,143,000

¹ Value included under "Miscellaneous."

² Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

³ Value not included in total value for State.

⁴ No canvass.

⁵ Exclusive of unclassified stone, value for which is included under "Miscellaneous."

⁶ From zinc-roasting operation.

⁷ Includes minerals indicated by "1" and "2" above.

IOWA

Cement.....	5,662,733	\$9,151,499	3,912,307	\$6,335,173	\$6,335,173
Clay.....	8,273	2,900,000	12,489	36,959	36,959
Products (other than pottery and refractories).....	2,947,722	8,408,131	2,770,610	8,575,522	8,575,522
Raw (sold or shipped by producers).....	(2)	(2)	(2)	(2)	(2)
Coal.....	514,587	688,211	413,092	596,902	596,902
Gypsum.....	(2)	(2)	(2)	(2)	(2)
Iron, pig.....	(2)	(2)	(2)	(2)	(2)
Iron, pig.....	(2)	(2)	(2)	(2)	(2)
Lime.....	(2)	(2)	(2)	(2)	(2)
Mineral waters.....	(2)	(2)	(2)	(2)	(2)
Pest.....	6,700,745	2,190,452	5,070,927	1,979,559	2,084,149
Mineral waters.....	4,849,803	4,849,803	4,327,782	4,327,782	4,327,782
Stone.....	4,474,480	5,635,297	3,544,560	3,563,020	3,563,020
Miscellaneous.....	(2)	(2)	(2)	(2)	(2)
Total value, eliminating duplications.....	28,278,387	24,157,000	24,483,000	24,483,000	24,483,000

¹ Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

² Value included under "Miscellaneous."

³ Value not included in total value for State.

⁴ No canvass.

⁵ Exclusive of dimension limestone, value for which is included under "Miscellaneous."

⁶ Includes minerals indicated by "1" and "2" above.

Mineral products of the United States, 1948-44, by States—Continued
KANSAS

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement.....	1 7, 726, 291	1 \$11, 415, 377	1 5, 305, 765	1 \$8, 035, 559	1 2, 866, 946	1 \$4, 454, 060
Clay:						
Products (other than pottery and refractories).....						
Raw (sold or shipped by producers).....		\$ 840, 000		\$ 700, 000		\$ 1, 100, 000
Coal.....	4, 223, 833	9, 298, 965	3, 436, 781	8, 606, 968	3, 610, 000	9, 350, 000
Gypsum (crude).....						
do.....						
Helium.....						
do.....						
Lead.....	9, 419	1, 292, 146	9, 213	1, 381, 920	9, 394	1, 503, 040
do.....						
Mineral paints (zinc and lead pigments).....						
Mineral waters.....						
Natural gas.....	112, 921, 000	38, 354, 000	133, 729, 000	49, 618, 000	148, 000, 000	56, 240, 000
Natural gasoline.....	68, 948, 000	2, 373, 000	70, 325, 000	2, 967, 000	54, 045, 000	2, 600, 000
Liquefied petroleum gases.....	12, 880, 000	422, 000	14, 881, 000	471, 000	15, 789, 000	525, 000
Ores (crude), etc.:						
Lead.....	15					
Zinc.....	1, 809, 552		2, 232, 495		2, 351, 168	
Zinc-lead.....	2, 062, 485		2, 243, 272		2, 878, 627	
Petroleum.....	97, 636, 000	117, 100, 000	106, 178, 000	127, 410, 000	98, 762, 000	120, 800, 000
do.....						
Pumice.....	96, 819	136, 990	43, 915	163, 866	43, 094	163, 588
Salt.....	800, 053	3, 804, 321	945, 257	4, 197, 507	932, 238	4, 357, 217
Sand and gravel.....	5, 201, 000	2, 775, 283	3, 615, 861	2, 103, 091	2, 786, 088	1, 602, 778
Stone.....	2, 588, 200	10, 331, 049	2, 074, 580	2, 291, 198	2, 121, 020	2, 069, 738
Zinc.....	55, 574	1, 392, 994	56, 944	12, 239, 994	65, 703	14, 324, 284
Miscellaneous ¹		2, 902, 880		2, 601, 179		3, 937, 901
Total value, eliminating duplications.....		201, 454, 022		220, 413, 000		219, 678, 000

¹ Exclusive of natural cement, value of which is included under "Miscellaneous."
² Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
³ Value included under "Miscellaneous."
⁴ Figures cover fiscal year ended June 30 of year stated.

⁵ Value not included in total value for State.
⁶ No canvass.
⁷ Not valued as ore; value of recoverable metal content included under the metals.
⁸ Includes minerals indicated by "1" and "9" above.

KENTUCKY

Asphalt (native).....	(1)	(1)	(1)	(1)	141, 208	\$978, 279
Barite.....						
Cement.....	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products (other than pottery and refractories).....						
Raw (sold or shipped by producers).....	503, 688	\$1, 300, 000	404, 278	\$1, 000, 000	372, 006	\$ 800, 000
Coal.....	62, 880, 766	1, 871, 403	63, 311, 473	1, 657, 398	68, 247, 000	1, 609, 478
do.....		146, 815, 230		170, 769, 859		203, 346, 000

	(1) 1914	(2) 1915	(3) 1916	(4) 1917	(5) 1918	(6) 1919	(7) 1920	(8) 1921	(9) 1922	(10) 1923	(11) 1924	(12) 1925	(13) 1926	(14) 1927	(15) 1928	(16) 1929	(17) 1930	(18) 1931	(19) 1932	(20) 1933	(21) 1934	(22) 1935	(23) 1936	(24) 1937	(25) 1938	(26) 1939	(27) 1940	(28) 1941	(29) 1942	(30) 1943	(31) 1944	(32) 1945	(33) 1946	(34) 1947	(35) 1948	(36) 1949	(37) 1950	(38) 1951	(39) 1952	(40) 1953	(41) 1954	(42) 1955	(43) 1956	(44) 1957	(45) 1958	(46) 1959	(47) 1960	(48) 1961	(49) 1962	(50) 1963	(51) 1964	(52) 1965	(53) 1966	(54) 1967	(55) 1968	(56) 1969	(57) 1970	(58) 1971	(59) 1972	(60) 1973	(61) 1974	(62) 1975	(63) 1976	(64) 1977	(65) 1978	(66) 1979	(67) 1980	(68) 1981	(69) 1982	(70) 1983	(71) 1984	(72) 1985	(73) 1986	(74) 1987	(75) 1988	(76) 1989	(77) 1990	(78) 1991	(79) 1992	(80) 1993	(81) 1994	(82) 1995	(83) 1996	(84) 1997	(85) 1998	(86) 1999	(87) 2000	(88) 2001	(89) 2002	(90) 2003	(91) 2004	(92) 2005	(93) 2006	(94) 2007	(95) 2008	(96) 2009	(97) 2010	(98) 2011	(99) 2012	(100) 2013	(101) 2014	(102) 2015	(103) 2016	(104) 2017	(105) 2018	(106) 2019	(107) 2020	(108) 2021	(109) 2022	(110) 2023	(111) 2024	(112) 2025	(113) 2026	(114) 2027	(115) 2028	(116) 2029	(117) 2030	(118) 2031	(119) 2032	(120) 2033	(121) 2034	(122) 2035	(123) 2036	(124) 2037	(125) 2038	(126) 2039	(127) 2040	(128) 2041	(129) 2042	(130) 2043	(131) 2044	(132) 2045	(133) 2046	(134) 2047	(135) 2048	(136) 2049	(137) 2050	(138) 2051	(139) 2052	(140) 2053	(141) 2054	(142) 2055	(143) 2056	(144) 2057	(145) 2058	(146) 2059	(147) 2060	(148) 2061	(149) 2062	(150) 2063	(151) 2064	(152) 2065	(153) 2066	(154) 2067	(155) 2068	(156) 2069	(157) 2070	(158) 2071	(159) 2072	(160) 2073	(161) 2074	(162) 2075	(163) 2076	(164) 2077	(165) 2078	(166) 2079	(167) 2080	(168) 2081	(169) 2082	(170) 2083	(171) 2084	(172) 2085	(173) 2086	(174) 2087	(175) 2088	(176) 2089	(177) 2090	(178) 2091	(179) 2092	(180) 2093	(181) 2094	(182) 2095	(183) 2096	(184) 2097	(185) 2098	(186) 2099	(187) 2100	(188) 2101	(189) 2102	(190) 2103	(191) 2104	(192) 2105	(193) 2106	(194) 2107	(195) 2108	(196) 2109	(197) 2110	(198) 2111	(199) 2112	(200) 2113	(201) 2114	(202) 2115	(203) 2116	(204) 2117	(205) 2118	(206) 2119	(207) 2120	(208) 2121	(209) 2122	(210) 2123	(211) 2124	(212) 2125	(213) 2126	(214) 2127	(215) 2128	(216) 2129	(217) 2130	(218) 2131	(219) 2132	(220) 2133	(221) 2134	(222) 2135	(223) 2136	(224) 2137	(225) 2138	(226) 2139	(227) 2140	(228) 2141	(229) 2142	(230) 2143	(231) 2144	(232) 2145	(233) 2146	(234) 2147	(235) 2148	(236) 2149	(237) 2150	(238) 2151	(239) 2152	(240) 2153	(241) 2154	(242) 2155	(243) 2156	(244) 2157	(245) 2158	(246) 2159	(247) 2160	(248) 2161	(249) 2162	(250) 2163	(251) 2164	(252) 2165	(253) 2166	(254) 2167	(255) 2168	(256) 2169	(257) 2170	(258) 2171	(259) 2172	(260) 2173	(261) 2174	(262) 2175	(263) 2176	(264) 2177	(265) 2178	(266) 2179	(267) 2180	(268) 2181	(269) 2182	(270) 2183	(271) 2184	(272) 2185	(273) 2186	(274) 2187	(275) 2188	(276) 2189	(277) 2190	(278) 2191	(279) 2192	(280) 2193	(281) 2194	(282) 2195	(283) 2196	(284) 2197	(285) 2198	(286) 2199	(287) 2200	(288) 2201	(289) 2202	(290) 2203	(291) 2204	(292) 2205	(293) 2206	(294) 2207	(295) 2208	(296) 2209	(297) 2210	(298) 2211	(299) 2212	(300) 2213	(301) 2214	(302) 2215	(303) 2216	(304) 2217	(305) 2218	(306) 2219	(307) 2220	(308) 2221	(309) 2222	(310) 2223	(311) 2224	(312) 2225	(313) 2226	(314) 2227	(315) 2228	(316) 2229	(317) 2230	(318) 2231	(319) 2232	(320) 2233	(321) 2234	(322) 2235	(323) 2236	(324) 2237	(325) 2238	(326) 2239	(327) 2240	(328) 2241	(329) 2242	(330) 2243	(331) 2244	(332) 2245	(333) 2246	(334) 2247	(335) 2248	(336) 2249	(337) 2250	(338) 2251	(339) 2252	(340) 2253	(341) 2254	(342) 2255	(343) 2256	(344) 2257	(345) 2258	(346) 2259	(347) 2260	(348) 2261	(349) 2262	(350) 2263	(351) 2264	(352) 2265	(353) 2266	(354) 2267	(355) 2268	(356) 2269	(357) 2270	(358) 2271	(359) 2272	(360) 2273	(361) 2274	(362) 2275	(363) 2276	(364) 2277	(365) 2278	(366) 2279	(367) 2280	(368) 2281	(369) 2282	(370) 2283	(371) 2284	(372) 2285	(373) 2286	(374) 2287	(375) 2288	(376) 2289	(377) 2290	(378) 2291	(379) 2292	(380) 2293	(381) 2294	(382) 2295	(383) 2296	(384) 2297	(385) 2298	(386) 2299	(387) 2300	(388) 2301	(389) 2302	(390) 2303	(391) 2304	(392) 2305	(393) 2306	(394) 2307	(395) 2308	(396) 2309	(397) 2310	(398) 2311	(399) 2312	(400) 2313	(401) 2314	(402) 2315	(403) 2316	(404) 2317	(405) 2318	(406) 2319	(407) 2320	(408) 2321	(409) 2322	(410) 2323	(411) 2324	(412) 2325	(413) 2326	(414) 2327	(415) 2328	(416) 2329	(417) 2330	(418) 2331	(419) 2332	(420) 2333	(421) 2334	(422) 2335	(423) 2336	(424) 2337	(425) 2338	(426) 2339	(427) 2340	(428) 2341	(429) 2342	(430) 2343	(431) 2344	(432) 2345	(433) 2346	(434) 2347	(435) 2348	(436) 2349	(437) 2350	(438) 2351	(439) 2352	(440) 2353	(441) 2354	(442) 2355	(443) 2356	(444) 2357	(445) 2358	(446) 2359	(447) 2360	(448) 2361	(449) 2362	(450) 2363	(451) 2364	(452) 2365	(453) 2366	(454) 2367	(455) 2368	(456) 2369	(457) 2370	(458) 2371	(459) 2372	(460) 2373	(461) 2374	(462) 2375	(463) 2376	(464) 2377	(465) 2378	(466) 2379	(467) 2380	(468) 2381	(469) 2382	(470) 2383	(471) 2384	(472) 2385	(473) 2386	(474) 2387	(475) 2388	(476) 2389	(477) 2390	(478) 2391	(479) 2392	(480) 2393	(481) 2394	(482) 2395	(483) 2396	(484) 2397	(485) 2398	(486) 2399	(487) 2400	(488) 2401	(489) 2402	(490) 2403	(491) 2404	(492) 2405	(493) 2406	(494) 2407	(495) 2408	(496) 2409	(497) 2410	(498) 2411	(499) 2412	(500) 2413	(501) 2414	(502) 2415	(503) 2416	(504) 2417	(505) 2418	(506) 2419	(507) 2420	(508) 2421	(509) 2422	(510) 2423	(511) 2424	(512) 2425	(513) 2426	(514) 2427	(515) 2428	(516) 2429	(517) 2430	(518) 2431	(519) 2432	(520) 2433	(521) 2434	(522) 2435	(523) 2436	(524) 2437	(525) 2438	(526) 2439	(527) 2440	(528) 2441	(529) 2442	(530) 2443	(531) 2444	(532) 2445	(533) 2446	(534) 2447	(535) 2448	(536) 2449	(537) 2450	(538) 2451	(539) 2452	(540) 2453	(541) 2454	(542) 2455	(543) 2456	(544) 2457	(545) 2458	(546) 2459	(547) 2460	(548) 2461	(549) 2462	(550) 2463	(551) 2464	(552) 2465	(553) 2466	(554) 2467	(555) 2468	(556) 2469	(557) 2470	(558) 2471	(559) 2472	(560) 2473	(561) 2474	(562) 2475	(563) 2476	(564) 2477	(565) 2478	(566) 2479	(567) 2480	(568) 2481	(569) 2482	(570) 2483	(571) 2484	(572) 2485	(573) 2486	(574) 2487	(575) 2488	(576) 2489	(577) 2490	(578) 2491	(579) 2492	(580) 2493	(581) 2494	(582) 2495	(583) 2496	(584) 2497	(585) 2498	(586) 2499	(587) 2500	(588) 2501	(589) 2502	(590) 2503	(591) 2504	(592) 2505	(593) 2506	(594) 2507	(595) 2508	(596) 2509	(597) 2510	(598) 2511	(599) 2512	(600) 2513	(601) 2514	(602) 2515	(603) 2516	(604) 2517	(605) 2518	(606) 2519	(607) 2520	(608) 2521	(609) 2522	(610) 2523	(611) 2524	(612) 2525	(613) 2526	(614) 2527	(615) 2528	(616) 2529	(617) 2530	(618) 2531	(619) 2532	(620) 2533	(621) 2534	(622) 2535	(623) 2536	(624) 2537	(625) 2538	(626) 2539	(627) 2540	(628) 2541	(629) 2542	(630) 2543	(631) 2544	(632) 2545	(633) 2546	(634) 2547	(635) 2548	(636) 2549	(637) 2550	(638) 2551	(639) 2552	(640) 2553	(641) 2554	(642) 2555	(643) 2556	(644) 2557	(645) 2558	(646) 2559	(647) 2560	(648) 2561	(649) 2562	(650) 2563	(651) 2564	(652) 2565	(653) 2566	(654) 2567	(655) 2568	(656) 2569	(657) 2570	(658) 2571	(659) 2572	(660) 2573	(661) 2574	(662) 2575	(663) 2576	(664) 2577	(665) 2578	(666) 2579	(667) 2580	(668) 2581	(669) 2582	(670) 2583	(671) 2584	(672) 2585	(673) 2586	(674) 2587	(675) 2588	(676) 2589	(677) 2590	(678) 2591	(679) 2592	(680) 2593	(681) 2594	(682) 2595	(683) 2596	(684) 2597	(685) 2598	(686) 2599	(687) 2600	(688) 2601	(689) 2602	(690) 2603	(691) 2604	(692) 2605	(693) 2606	(694) 2607	(695) 2608	(696) 2609	(697) 2610	(698) 2611	(699) 2612	(700) 2613	(701) 2614	(702) 2615	(703) 2616	(704) 2617	(705) 2618	(706) 2619	(707) 2620	(708) 2621	(709) 2622	(710) 2623	(711) 2624	(712) 2625	(713) 2626	(714) 2627	(715) 2628	(716) 2629	(717) 2630	(718) 2631	(719) 2632	(720) 2633	(721) 2634	(722) 2635	(723) 2636	(724) 2637	(725) 2638	(726) 2639	(727) 2640	(728) 2641	(729) 2642	(730) 2643	(731) 2644	(732) 2645	(733) 2646	(734) 2647	(735) 2648	(736) 2649	(737) 2650	(738) 2651	(739) 2652	(740) 2653	(741) 2654	(742) 2655	(743) 2656	(744) 2657	(745) 2658	(746) 2659	(747) 2660	(748) 2661	(749) 2662	(750) 2663	(751) 2664	(752) 2665	(753) 2666	(754) 2667	(755) 2668	(756) 2669	(757) 2670	(758) 2671	(759) 2672	(760) 2673	(761) 2674	(762) 2675	(763) 2676	(764) 2677	(765) 2678	(766) 2679	(767) 2680	(768) 2681	(769) 2682	(770) 2683	(771) 2684	(772) 2685	(773) 2686	(774) 2687	(775) 2688	(776) 2689	(777) 2690	(778) 2691	(779) 2692	(780) 2693	(781) 2694	(782) 2695	(783) 2696	(784) 2697	(785) 2698	(786) 2699	(787) 2700	(788) 2701	(789) 2702	(790) 2703	(791) 2704	(792) 2705	(793) 2706	(794) 2707	(795) 2708	(796) 2709	(797) 2710	(798) 2711	(799) 2712	(800) 2713	(801) 2714	(802) 2715	(803) 2716	(804) 2717	(805) 2718	(806) 2719	(807) 2720	(808) 2721	(809) 2722	(810) 2723	(811) 2724	(812) 2725	(813) 2726	(814) 2727	(815) 2728	(816) 2729	(817) 2730	(818) 2731	(819) 2732	(820) 2733	(821) 2734	(822) 2735	(823) 2736	(824) 2737	(825) 2738	(82
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Mineral products of the United States, 1943-44, by States—Continued

MAINE

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Beryllium ore.....	45	(1)	2	\$169	2	\$267
Cement.....	(1)	(1)	(1)	(1)	(1)	(1)
Clay products (other than pottery and refractories).....	8,335	\$300,000	6,748	\$120,000	8,011	(1)
Feldspar (crude).....	(1)	\$3,143	(1)	\$41,652	(1)	\$47,892
Gems and precious stones.....	(1)	(1)	(1)	(1)	(1)	(1)
Lime.....	103	4,328	(1)	(1)	(1)	(1)
Lithium minerals.....	(1)	(1)	(1)	(1)	(1)	(1)
Mica:						
Scrap.....	(1)	(1)	240	5,862	64	1,602
Sheet.....	3,122	1,946	51,576	63,845	28,008	40,803
Mineral waters.....	(1)	(1)	(1)	(1)	(1)	(1)
Peat.....	3,832	110,478	1,871	60,033	2,276	80,732
Sand and gravel.....	2,249,254	800,147	1,603,324	733,803	1,940,066	710,047
Silica (quartz).....	364	922	140	840	88	203
Slate.....	480,391	480,391	201,450	(1)	125,840	(1)
Stone.....	419,610	4,556,655	201,450	409,780	125,840	332,736
Miscellaneous ¹	(1)	1,306,044	(1)	1,284,761	125,840	332,131
Total value, eliminating duplications.....		3,614,054		2,720,000		2,146,000

¹ Value included under "Miscellaneous."² Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.³ No canvass.⁴ Exclusive of unclassified stone in 1942 and of basalt in 1944, value for which is included under "Miscellaneous."⁵ Includes minerals indicated by "1" and "a" above.

MARYLAND

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement.....	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products (other than pottery and refractories).....	57,599	\$1,600,000	50,547	\$1,400,000	37,946	(1)
Raw (sold or shipped by producers).....	2,000,934	127,227	1,933,380	133,831	1,960,000	\$156,562
Coal.....	2,103,664	5,205,516	2,059,839	5,812,623	2,088,233	6,546,000
Coke.....	2,493,946	(1)	2,626,748	(1)	2,614,735	(1)
Iron, pig.....	62,871	371,189	78,386	530,989	69,514	534,743
Lime.....	(1)	(1)	(1)	(1)	(1)	(1)
Mica, scrap.....	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters.....	(1)	(1)	(1)	(1)	(1)	(1)
Potassium salts.....	(1)	(1)	(1)	(1)	(1)	(1)

Office and general minerals	Office (quartz)	Office (quartz)	Office (quartz)	Office (quartz)	Office (quartz)	Office (quartz)
1,200,100	1,200,100	1,200,100	1,200,100	1,200,100	1,200,100	1,200,100
18,264	18,264	18,264	18,264	18,264	18,264	18,264
74,094,716	74,094,716	74,094,716	74,094,716	74,094,716	74,094,716	74,094,716
18,388,878	18,388,878	18,388,878	18,388,878	18,388,878	18,388,878	18,388,878
17,308,000	17,308,000	17,308,000	17,308,000	17,308,000	17,308,000	17,308,000
15,899,000	15,899,000	15,899,000	15,899,000	15,899,000	15,899,000	15,899,000

Total value, eliminating duplications.....

* No census.
 * Exclusive of dimension limestone, value for which is included under "Miscellaneous."
 * Estimated by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
 * Value not included in total value for State.

MASSACHUSETTS

Barium ore.....	short tons	Value	Value	Value	Value	Value
Clay.....	do	1,176,359	1,176,359	1,176,359	1,176,359	1,176,359
Products (other than pottery and refractories).....	do	87,537	87,537	87,537	87,537	87,537
Raw (sold for shipped by producers).....	do	3,301	3,301	3,301	3,301	3,301
Coke.....	do	11	11	11	11	11
Iron, pig.....	do	11	11	11	11	11
Manganese.....	do	11	11	11	11	11
Manganese ore.....	do	11	11	11	11	11
Mica.....	do	11	11	11	11	11
Mineral waters.....	do	11	11	11	11	11
Peat.....	do	11	11	11	11	11
Sand and gravel.....	do	11	11	11	11	11
Sand and sandstone (ground).....	do	11	11	11	11	11
Silica (quartz).....	do	11	11	11	11	11
Stone.....	do	11	11	11	11	11
Miscellaneous.....	do	11	11	11	11	11
Total value, eliminating duplications.....						

* Value included under "Miscellaneous."
 * Estimated by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
 * Value not included in total value for State.
 No census.

Mineral products of the United States, 1942-44, by States—Continued

MICHIGAN

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Bromine.....	17,685,316	\$4,589,747	19,846,772	\$5,447,966	17,264,185	\$4,918,686
Calcium chloride.....	190,422	1,487,597	175,926	1,384,818	1,441,882	1,441,882
Clay.....	10,346,104	14,688,688	6,450,404	9,285,815	5,177,176	7,733,185
Products (other than pottery and refractories)						
Raw (sold or shipped by producers)		12,200,000		11,500,000		11,000,000
Coal.....	(¹)	(¹)	148,178	117,833	(¹)	(¹)
Coke.....	231,148	1,020,833	820,995	820,995	160,000	867,000
Copper.....	3,139,137	21,793,813	2,948,389	22,000,821	3,003,424	24,848,897
Gems and precious stones	91,338,000	11,054,318	93,528,000	12,168,640	84,842,000	11,458,670
Gypsum (crude).....	891,180	1,286,242	538,022	737,719	552,672	891,965
Iron.....						
Ore.....	16,129,474	45,599,536	14,510,357	40,258,096	13,693,377	38,137,000
Pig.....	1,673,143	25,718,214	1,492,942	24,782,464	1,617,912	(¹)
Lime.....	38,283	420,523	96,554	717,401	119,446	869,337
Magnesium.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Magnesium compounds (natural)	209,020,632	3,497,991	241,124,000	4,446,052	209,948,000	6,031,551
Manganiferous ore.....	34,643	(¹)	100,062	(¹)	45,689	(¹)
Marl, calcareous.....	62,886	31,834	16,004	10,770	(¹)	(¹)
Mineral waters.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Natural gas.....	15,521,000	11,044,000	18,006,000	12,567,000	19,600,000	13,622,000
Natural gasoline and allied products:						
Natural gasoline.....	2,518,000	120,000	1,226,000	59,000	4,055,000	210,000
Liquefied petroleum gases.....					4,445,000	147,000
Ores (crude), etc.: Copper	4,362,640	(¹)	4,403,594	(¹)	5,410,238	(¹)
Peat.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Petroleum.....	21,754,000	30,300,000	20,768,000	29,280,000	18,490,000	26,600,000
Salt.....	3,946,391	12,583,964	4,284,085	14,472,820	4,287,738	14,921,719
Sand and gravel.....	15,542,941	7,362,231	11,750,989	5,585,850	12,184,853	6,103,196
Silver.....	61,674	43,887	48,479	34,474	54,218	38,855
Stone.....	16,063,650	9,433,035	15,919,780	9,669,672	15,789,320	8,709,353
Miscellaneous ¹		4,734,531		8,459,065		35,733,578
Total value, eliminating duplications.....		161,433,922		157,016,000		151,992,000

¹ Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.² Value included under "Miscellaneous."³ Value not included in total value for State.⁴ No census.⁵ Not valued as ore; value of recoverable metal content included under the metals.⁶ Includes minerals indicated by "r" above.

Commodity	(t)	(c)	(c)	(c)	(c)	(c)	(c)
Clay.....			\$800,000				
Products (other than pottery and refractories).....			\$7,507,413				
Raw (sold or shipped by producers).....							\$87,979,053
Coke.....							
Raw (sold or shipped by producers).....							
Flint for tube mills.....							
Gems and precious stones.....							
Iron.....							
Ore.....			179,752,235				
Pig.....							
Lime.....			3,937,679				
Manganiferous ore.....							
Marl, calcareous.....			1,588,960				
Mineral waters.....							
Peat.....			2,427				
Pebbles for grinding.....							
Sand and gravel.....			10,900,493				
Stone.....			\$1,858,631				
Miscellaneous ¹			\$1,451,210				
Total value, eliminating duplications.....			191,649,723				170,465,000

¹ Value included under "Miscellaneous."

² Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

³ Value not included in total value for State.

⁴ No canvass.

⁵ Exclusive of basalt in 1942 of basalt and marble in 1943, and of marble and unclassified stone in 1944, value for which is included under "Miscellaneous."

⁶ Includes minerals indicated by "i" and "g" above.

MISSISSIPPI

Commodity	(t)	(c)	(c)	(c)	(c)	(c)	(c)
Bauxite.....							
Clay.....							
Products (other than pottery and refractories).....			\$700,000				
Raw (sold or shipped by producers).....							\$800,000
Mineral waters.....							
Natural gas.....			2,052,000				
Petroleum.....			28,833,000				
Sand and gravel.....			1,766,367				
Stone.....							
Miscellaneous ¹			369,557				
Total value, eliminating duplications.....			29,992,924				18,988,000

¹ Value included under "Miscellaneous."

² Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

³ No canvass.

⁴ "Commercial."

⁵ Value of "Government-and-contractor" included under "Miscellaneous."

⁶ Includes minerals indicated by "i" and "g" above.

Mineral products of the United States, 1942-44, by States—Continued

MISSOURI

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Asphalt (native).....	(1)	(1)	(1)	(1)	(1)	(1)
Barite.....	146,270	\$943,131	124,147	\$872,044	150,748	\$1,121,678
Cement.....	7,397,960	11,515,907	4,464,943	7,024,285	3,061,434	4,881,516
Clay.....						
Products (other than pottery and refractories).....						
Raw (sold or shipped by producers).....	1,132,842	\$2,300,000	1,245,492	\$2,540,557	927,770	\$1,400,000
Coal.....	3,519,877	2,468,170	4,309,636	10,755,849	4,530,000	1,805,495
Cobalt.....	(1)	(1)	(1)	(1)	(1)	(1)
Coke.....	2,600,000	314,600	2,680,000	348,400	6,604,000	801,540
Copper.....	55,578	177,587	52,893	133,997	19,233	69,540
Iron ore.....	199,548	26,739,432	184,910	27,736,500	174,683	27,940,280
Lead.....	833,020	4,915,784	963,301	6,046,453	908,340	5,820,028
Lime.....	(1)	(1)	(1)	(1)	(1)	(1)
Manganese ore.....	239	(1)	180	(1)	(1)	(1)
Mineral paints (zinc and lead pigments).....	(1)	(1)	(1)	(1)	(1)	(1)
Natural waters.....	(1)	(1)	(1)	(1)	(1)	(1)
Nickel.....	100,000	52,000	124,000	67,000	160,000	86,000
Ores (crude), etc.:.....						
Lead-copper.....	7,107,453	(1)	6,832,794	(1)	6,432,794	(1)
Zinc.....	823,305	(1)	1,244,418	(1)	1,222,856	(1)
Zinc-lead.....	1,368,000	(1)	1,362,939	(1)	876,198	(1)
Petroleum.....	36,000	41,000	36,000	41,000	1,738,333	(1)
Sand and gravel.....	4,490,650	2,931,924	3,250,533	2,298,556	3,183,176	2,370,261
Silver.....	69,106	49,142	111,285	179,136	(1)	65,605
Stone.....	9,235,540	\$8,347,132	5,636,040	5,864,005	4,856,540	5,312,384
Tripoli.....	(1)	(1)	(1)	(1)	(1)	(1)
Tungsten ore (60-percent concentrates).....						
Zinc.....	36,394	6,769,284	30,413	6,569,208	36,626	8,350,728
Miscellaneous.....		2,664,855		2,979,865		3,325,624
Total value, eliminating duplications.....		76,122,304		72,212,000		72,369,000

¹ Value included under "Miscellaneous."

² Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

³ Value not included in total value for State.

⁴ No canvas.

⁵ Not valued as ore; value of recoverable metal content included under the metals.
⁶ Exclusive of crushed marble, value for which is included under "Miscellaneous."
⁷ Includes minerals indicated by "1" and "4" above.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Chromite.....	(1)	65,218	(1)	70,001	(1)	\$1,481,085	(1)	1,251	(1)
Clay:									
Products (other than pottery and refractories).									
Raw (sold or shipped by producers).									
Bituminous.....		200,000							9,062,000
Lignite.....		8,270							31,911,300
Coal:									
do.....		3,779,544							1,750,735
Lignite.....		40,138							7,000
Copper.....		282,388,000							2,066,500
do.....		34,168,948							5,965,002
Gems and precious stones.....		(1)							15,999
Gold.....		146,892							(1)
do.....		5,141,220							32,500,000
Graphite, crystalline.....		(1)							200,000
Gypsum (crude).....		20,050							110,000
do.....		2,586,700							5,340,862
Lead.....		(1)							231,309
do.....		16,324							16,857
Lime.....		(1)							201,470
do.....		138,115							258,874
Manganese ore.....		2,041							8,627,000
do.....		(1)							186,454
Mica, sheet.....		(1)							(1)
Mineral waters.....		31,562,000							8,190,000
Natural gas.....		8,233,000							2,895,000
Natural gasoline.....		201,000							1,882,000
do.....		96,000							5,340,862
Liquefied petroleum gases.....		(1)							231,309
Ores (crude), etc.:									16,857
Copper.....		4,338,714							201,470
Dry and siliceous (gold and silver).....		533,524							258,874
Lead.....		15,936							8,627,000
Zinc.....		218,235							186,454
Zinc-lead.....		571,871							(1)
Petroleum.....		8,074,000							10,800,000
do.....		130,462							761,745
Platinum metals (crude).....		(1)							(1)
Pyrites.....		5,246,242							(1)
Sand and gravel.....		11,188,118							4,308,811
Stone.....		383,200							7,062,215
do.....		(1)							\$232,060
Talc.....		(1)							(1)
Tungsten ore (60-percent concentrates).....		(1)							25
Vermiculite.....		(1)							(1)
Zinc.....		54,715							36,127
Miscellaneous.....		961,981,004							8,233,000
Total value, eliminating duplications.....									2,495,254
									89,479,000

1 Value included under "Miscellaneous."
 2 Figures not available.
 3 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
 4 No census.
 5 Not valued as ore; value of recoverable metal content included under the metals.
 6 Exclusive of dimension basalt, value for which is included under "Miscellaneous."
 7 Includes minerals indicated by "1" and "4" above.

Mineral products of the United States, 1942-44, by States—Continued
NEBRASKA

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement.....	(1)	(1)	(1)	(1)	(1)	(1)
Clay.....	(1)	(1)	(1)	(1)	(1)	(1)
Products (other than pottery and refractories)						
Raw (sold or shipped by producers)	16,983	\$400,000	12,737	\$400,000	(1)	\$320,000
Mineral waters.....	(1)	(1)	(1)	(1)	(1)	(1)
Petroleum.....	1,237,000	13,991	635,000	14,754	(1)	(1)
Pumice.....	6,837	1,110,000	(1)	570,000	417,000	460,000
Sand and gravel.....	6,527,665	47,194	4,528,510	(1)	6,083	51,043
Stone.....	267,020	3,241,622	538,380	2,391,483	3,984,983	1,896,777
Miscellaneous.....		630,413		983,932	166,720	1,483,563
		2,984,980		2,454,833		1,848,814
Total value, eliminating duplications.....		8,428,200		6,800,000		5,060,000

¹ Value included under "Miscellaneous."

² Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

NEVADA

Antimony ore (concentrates).....	305	\$12,837	84	\$5,372	74	\$6,583
Arsenious oxide.....	(1)	(1)	(1)	(1)	(1)	(1)
Barite.....	(1)	(1)	12,157	46,900	22,390	84,859
Bismuth.....	(1)	(1)	(1)	(1)	(1)	(1)
Clay.....	(1)	(1)	(1)	(1)	(1)	(1)
Products (other than pottery and refractories)						
Raw (sold or shipped by producers)						
Cobalt.....	(1)	(1)	(1)	(1)	(1)	(1)
Copper.....	167,326,000	20,246,446	142,136,000	18,477,680	122,464,000	16,532,640
Diatomite.....	(1)	(1)	(1)	(1)	(1)	(1)
Dumortierite.....	(1)	(1)	(1)	(1)	(1)	(1)
Fluorspar.....	8,020	(1)	8,653	(1)	7,283	(1)
Fuller's earth.....	(1)	(1)	(1)	(1)	(1)	(1)
Gems and precious stones.....						
Gold.....	295,112	10,328,920	144,442	5,055,470	119,056	4,166,960
Graphite, amorphous.....	330,333	540,579	347,981	702,908	392,748	683,107
Gypsum (crude).....	(1)	(1)	7,368	32,281	230,684	230,684
Iron ore.....	(1)	(1)	4,790	718,500	6,905	1,056,800
Lead.....	5,376	720,384	(1)	(1)	(1)	(1)
Lime.....	(1)	(1)	(1)	(1)	(1)	(1)
Magnesite.....	(1)	(1)	(1)	(1)	(1)	(1)
Magnesium.....	(1)	(1)	(1)	(1)	(1)	(1)
Magnesium oxide (hydrated) (brucite).....	(1)	(1)	(1)	(1)	(1)	(1)
Manganese ore.....	(1)	(1)	(1)	(1)	(1)	(1)
Manganiferous ore.....	6,112	(1)	10,451	970,196	33,368	13,947,785

	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)	(u)	(v)	(w)	(x)	(y)	(z)	(aa)	(ab)	(ac)	(ad)	(ae)	(af)	(ag)	(ah)	(ai)	(aj)	(ak)	(al)	(am)	(an)	(ao)	(ap)	(aq)	(ar)	(as)	(at)	(au)	(av)	(aw)	(ax)	(ay)	(az)	(ba)	(bb)	(bc)	(bd)	(be)	(bf)	(bg)	(bh)	(bi)	(bj)	(bk)	(bl)	(bm)	(bn)	(bo)	(bp)	(bq)	(br)	(bs)	(bt)	(bu)	(bv)	(bw)	(bx)	(by)	(bz)	(ca)	(cb)	(cc)	(cd)	(ce)	(cf)	(cg)	(ch)	(ci)	(cj)	(ck)	(cl)	(cm)	(cn)	(co)	(cp)	(cq)	(cr)	(cs)	(ct)	(cu)	(cv)	(cw)	(cx)	(cy)	(cz)	(da)	(db)	(dc)	(dd)	(de)	(df)	(dg)	(dh)	(di)	(dj)	(dk)	(dl)	(dm)	(dn)	(do)	(dp)	(dq)	(dr)	(ds)	(dt)	(du)	(dv)	(dw)	(dx)	(dy)	(dz)	(ea)	(eb)	(ec)	(ed)	(ee)	(ef)	(eg)	(eh)	(ei)	(ej)	(ek)	(el)	(em)	(en)	(eo)	(ep)	(eq)	(er)	(es)	(et)	(eu)	(ev)	(ew)	(ex)	(ey)	(ez)	(fa)	(fb)	(fc)	(fd)	(fe)	(ff)	(fg)	(fh)	(fi)	(fj)	(fk)	(fl)	(fm)	(fn)	(fo)	(fp)	(fq)	(fr)	(fs)	(ft)	(fu)	(fv)	(fw)	(fx)	(fy)	(fz)	(ga)	(gb)	(gc)	(gd)	(ge)	(gf)	(gg)	(gh)	(gi)	(gj)	(gk)	(gl)	(gm)	(gn)	(go)	(gp)	(gq)	(gr)	(gs)	(gt)	(gu)	(gv)	(gw)	(gx)	(gy)	(gz)	(ha)	(hb)	(hc)	(hd)	(he)	(hf)	(hg)	(hh)	(hi)	(hj)	(hk)	(hl)	(hm)	(hn)	(ho)	(hp)	(hq)	(hr)	(hs)	(ht)	(hu)	(hv)	(hw)	(hx)	(hy)	(hz)	(ia)	(ib)	(ic)	(id)	(ie)	(if)	(ig)	(ih)	(ii)	(ij)	(ik)	(il)	(im)	(in)	(io)	(ip)	(iq)	(ir)	(is)	(it)	(iu)	(iv)	(iw)	(ix)	(iy)	(iz)	(ja)	(jb)	(jc)	(jd)	(je)	(jf)	(jg)	(jh)	(ji)	(jj)	(jk)	(jl)	(jm)	(jn)	(jo)	(jp)	(jq)	(jr)	(js)	(jt)	(ju)	(jv)	(jw)	(jx)	(jy)	(jz)	(ka)	(kb)	(kc)	(kd)	(ke)	(kf)	(kg)	(kh)	(ki)	(kj)	(kk)	(kl)	(km)	(kn)	(ko)	(kp)	(kq)	(kr)	(ks)	(kt)	(ku)	(kv)	(kw)	(kx)	(ky)	(kz)	(la)	(lb)	(lc)	(ld)	(le)	(lf)	(lg)	(lh)	(li)	(lj)	(lk)	(ll)	(lm)	(ln)	(lo)	(lp)	(lq)	(lr)	(ls)	(lt)	(lu)	(lv)	(lw)	(lx)	(ly)	(lz)	(ma)	(mb)	(mc)	(md)	(me)	(mf)	(mg)	(mh)	(mi)	(mj)	(mk)	(ml)	(mm)	(mn)	(mo)	(mp)	(mq)	(mr)	(ms)	(mt)	(mu)	(mv)	(mw)	(mx)	(my)	(mz)	(na)	(nb)	(nc)	(nd)	(ne)	(nf)	(ng)	(nh)	(ni)	(nj)	(nk)	(nl)	(nm)	(nn)	(no)	(np)	(nq)	(nr)	(ns)	(nt)	(nu)	(nv)	(nw)	(nx)	(ny)	(nz)	(oa)	(ob)	(oc)	(od)	(oe)	(of)	(og)	(oh)	(oi)	(oj)	(ok)	(ol)	(om)	(on)	(oo)	(op)	(oq)	(or)	(os)	(ot)	(ou)	(ov)	(ow)	(ox)	(oy)	(oz)	(pa)	(pb)	(pc)	(pd)	(pe)	(pf)	(pg)	(ph)	(pi)	(pj)	(pk)	(pl)	(pm)	(pn)	(po)	(pp)	(pq)	(pr)	(ps)	(pt)	(pu)	(pv)	(pw)	(px)	(py)	(pz)	(qa)	(qb)	(qc)	(qd)	(qe)	(qf)	(qg)	(qh)	(qi)	(qj)	(qk)	(ql)	(qm)	(qn)	(qo)	(qp)	(qq)	(qr)	(qs)	(qt)	(qu)	(qv)	(qw)	(qx)	(qy)	(qz)	(ra)	(rb)	(rc)	(rd)	(re)	(rf)	(rg)	(rh)	(ri)	(rj)	(rk)	(rl)	(rm)	(rn)	(ro)	(rp)	(rq)	(rr)	(rs)	(rt)	(ru)	(rv)	(rw)	(rx)	(ry)	(rz)	(sa)	(sb)	(sc)	(sd)	(se)	(sf)	(sg)	(sh)	(si)	(sj)	(sk)	(sl)	(sm)	(sn)	(so)	(sp)	(sq)	(sr)	(ss)	(st)	(su)	(sv)	(sw)	(sx)	(sy)	(sz)	(ta)	(tb)	(tc)	(td)	(te)	(tf)	(tg)	(th)	(ti)	(tj)	(tk)	(tl)	(tm)	(tn)	(to)	(tp)	(tq)	(tr)	(ts)	(tt)	(tu)	(tv)	(tw)	(tx)	(ty)	(tz)	(ua)	(ub)	(uc)	(ud)	(ue)	(uf)	(ug)	(uh)	(ui)	(uj)	(uk)	(ul)	(um)	(un)	(uo)	(up)	(uq)	(ur)	(us)	(ut)	(uu)	(uv)	(uw)	(ux)	(uy)	(uz)	(va)	(vb)	(vc)	(vd)	(ve)	(vf)	(vg)	(vh)	(vi)	(vj)	(vk)	(vl)	(vm)	(vn)	(vo)	(vp)	(vq)	(vr)	(vs)	(vt)	(vu)	(vv)	(vw)	(vx)	(vy)	(vz)	(wa)	(wb)	(wc)	(wd)	(we)	(wf)	(wg)	(wh)	(wi)	(wj)	(wk)	(wl)	(wm)	(wn)	(wo)	(wp)	(wq)	(wr)	(ws)	(wt)	(wu)	(wv)	(ww)	(wx)	(wy)	(wz)	(xa)	(xb)	(xc)	(xd)	(xe)	(xf)	(xg)	(xh)	(xi)	(xj)	(xk)	(xl)	(xm)	(xn)	(xo)	(xp)	(xq)	(xr)	(xs)	(xt)	(xu)	(xv)	(xw)	(xx)	(xy)	(xz)	(ya)	(yb)	(yc)	(yd)	(ye)	(yf)	(yg)	(yh)	(yi)	(yj)	(yk)	(yl)	(ym)	(yn)	(yo)	(yp)	(yq)	(yr)	(ys)	(yt)	(yu)	(yv)	(yw)	(yx)	(yy)	(yz)	(za)	(zb)	(zc)	(zd)	(ze)	(zf)	(zg)	(zh)	(zi)	(zj)	(zk)	(zl)	(zm)	(zn)	(zo)	(zp)	(zq)	(zr)	(zs)	(zt)	(zu)	(zv)	(zw)	(zx)	(zy)	(zz)
Quartz crystal																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

1 Value included under "Miscellaneous."
 2 Figures not available.
 3 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
 4 No canvas.
 5 Not valued as ore; value of recoverable metal content included under the metals.
 6 Includes minerals indicated by "1," above.

NEW HAMPSHIRE

	16	\$1,286	42	\$6,305	(1)	(1)
Beryllium ore.....	short tons	230,000		200,000		(1)
Clay products (other than pottery and refractories).....	long tons	241,990	(1)	(1)	(1)	(1)
Feldspar (crude).....				(1)		(1)
Gems and precious stones.....						(1)
Mica:						
Scrap.....	303	7,224	1,148	28,643	2,339	\$55,851
Sheet.....	342,939	57,995	700,543	583,543	323,636	617,172
Mineral waters.....			(1)	(1)	(1)	(1)
Peat.....	(1)		80	1,705	(1)	(1)
Sand and gravel.....	1,287,394	159,058	611,582	126,325	838,668	120,943
Scythstones.....	do.	(1)	(1)	(1)	(1)	(1)
Stone.....	237,090	440,714	70,910	171,371	910	48,000
Miscellaneous.....		12,907		231,666		323,774
Total value, eliminating duplications.....		1,211,184		1,350,000		1,166,000

1 Value included under "Miscellaneous."
 2 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
 3 No canvas.
 4 Includes minerals indicated by "i" above.

Mineral products of the United States, 1942-44, by States—Continued

NEW YORK

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Aluminum.....	(1) (2)	(1) (2)	(1) (2)	(1) (2)	(1) (2)	(1) (2)
Cement.....	11,027, 118	\$16,030,995	5,914,660	\$8,765,665	3,411,605	\$6,839,676
Clay.....	(1)	6,000,000	(1)	3,000,000	(1)	1,500,000
Products (other than pottery and refractories).....	5,180,384	237,660,727	5,347,369	239,091,661	6,102,560	247,155,591
Raw (sold or shipped by producers).....	(1)	49,413	(1)	63,195	(1)	64,858
Coke.....	5,277	(1)	6,666	(1)	6,940	(1)
Diatomite.....	(1)	59,581,481	399,070	260,578,749	324,302	255,670,642
Emery.....	389,294	(1)	(1)	(1)	(1)	(1)
Feldspar (crude).....	(1)	(1)	(1)	(1)	(1)	(1)
Ferro-alloys.....	(1)	(1)	(1)	(1)	(1)	(1)
Garnet, abrasive.....	(1)	(1)	(1)	(1)	(1)	(1)
Gems and precious stones.....	(1) (2)	(1) (2)	(1) (2)	(1) (2)	(1) (2)	(1) (2)
Graphite.....	(1)	(1)	(1)	(1)	(1)	(1)
Artificial.....	(1)	(1)	(1)	(1)	(1)	(1)
Crystalline.....	1,012,987	1,605,530	713,961	1,229,796	594,067	1,128,821
Gypsum (crude).....	(1)	(1)	(1)	(1)	(1)	(1)
Iron.....	4,011,238	278,734,591	3,953,462	279,873,775	3,836,078	276,575,005
Ore.....	2,434	326,156	2,355	353,250	1,644	263,040
Pig.....	68,443	552,411	121,890	976,662	193,305	1,410,956
Lead.....	(1)	(1)	(1)	(1)	1,380	565,800
Lime.....	(1)	(1)	(1)	(1)	(1)	(1)
Magnetite.....	(1)	(1)	(1)	(1)	(1)	(1)
Manganese.....	(1)	(1)	(1)	(1)	(1)	(1)
Marble.....	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters.....	(1)	(1)	(1)	(1)	(1)	(1)
Natural gas.....	8,718,000	6,498,000	8,062,000	5,994,000	7,600,000	5,587,000
Natural gasoline.....	15,000	1,000	12,000	1,000	12,000	1,000
Ores (crude), etc.....	(1)	(1)	(1)	(1)	(1)	(1)
Zinc.....	167,923	(1)	154,001	(1)	120,106	(1)
Pearl.....	380,863	(1)	359,944	(1)	303,451	(1)
Petroleum.....	9,000	41,000	(1)	(1)	(1)	(1)
Perlite.....	5,421,000	16,000,000	5,059,000	15,230,000	4,697,000	15,600,000
Salt.....	68,896	250,527	62,907	227,723	(1)	(1)
Sand.....	2,792,670	8,118,147	2,926,388	9,328,672	2,925,675	9,899,580
Sand and gravel.....	16,286,367	11,841,245	17,375,378	7,260,547	7,049,583	4,308,390
Silica (quartz).....	(1)	(1)	(1)	(1)	(1)	(1)

Product	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911	2912	2913	2914	29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Mineral products of the United States, 1948-44, by States—Continued

NORTH CAROLINA—Continued

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Quartz crystal..... pounds						
Sand and gravel..... short tons	4, 280, 198	\$2, 491, 820	3, 046, 168	\$1, 323, 516	2, 535, 601	\$1, 405, 917
Sand and sandstone (ground)..... do						
Silica (quartz)..... do						
Silver..... troy ounces	(1)	(1)	(1)	(1)	(1)	(1)
Stone..... short tons	8, 259	5, 873	7, 160	5, 068	1, 461	1, 039
Talc, pyrophyllite, and ground soapstone..... do	3, 039, 580	2, 774, 472	4, 871, 260	5, 378, 900	4, 659, 540	5, 973, 951
Tantalum and columbium ores: Columblum ore..... pounds	56, 909	563, 062	65, 698	580, 106	60, 892	645, 156
Tin (metallic equivalent)..... do			4, 219	1, 055		
Tungsten concentrates: Ilmenite..... short tons	(1)	(1)	(1)	(1)	100	50
Tungsten ores (60-percent concentrates)..... do					16, 323	224, 680
Vermiculite..... do	1, 612	19, 124, 101	(1)	(1)	18, 186	(1)
Miscellaneous..... do					(1)	(1)
Total value, eliminating duplications.....		17, 372, 690		23, 897, 592		10, 998, 601
				22, 172, 000		22, 199, 000

1 Value included under "Miscellaneous."

2 Value not included in total value for State.

3 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

4 No canvass.

5 Not valued as ore; value of recoverable metal content included under the metals.

6 Figures not available.

7 Includes minerals indicated by "1" above.

NORTH DAKOTA

Clay:						
Products (other than pottery and refractories).....						
Raw (sold or shipped by producers)..... short tons	(1)	(1)	(1)	(1)	(1)	(1)
Coal..... do	2, 537, 016	\$3, 554, 000	2, 500, 202	\$3, 752, 000	2, 490, 000	\$3, 810, 000
Mineral waters..... do	(1)	(1)	(1)	(1)	(1)	(1)
Natural gas..... gallons sold	122, 000	40, 000	177, 000	60, 000	200, 000	68, 000
Sand and gravel..... short tons	2, 509, 684	343, 612	1, 459, 232	550, 263	2, 127, 029	733, 340
Stone..... do	(1)	(1)				
Miscellaneous..... do		90, 396		60, 024		60, 024
Total value, eliminating duplications.....		4, 028, 008		4, 422, 000		4, 671, 000

1 Value included under "Miscellaneous."

2 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

3 No canvass.

4 Includes minerals indicated by "1" above.

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911	2912	2913	2914	2915	2916	2917	2918	2919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Value included under "Miscellaneous."

¹ Value included under "Miscellaneous."

- ; Exclusive of natural cement, value for which is included under "Miscellaneous."
- ; Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

g certain classes of clay products.
Value not included in total value for State.

No can pass.

No can vass. value for which is included under "Miscellaneous."

**Exclusive of unclassified stone,
From incising operation.**

* From zinc-roasting operation.
† Includes minerals indicated by "1," "3," and "4" above.

Mineral products of the United States, 1942-44, by States—Continued

OKLAHOMA

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Asphalt (native).....	(1)	(1)	(1)	(1)	(1)	(1)
Cement.....	(1)	(1)	(1)	(1)	(1)	(1)
Clay.....	(1)	(1)	(1)	(1)	(1)	(1)
Products (other than pottery and refractories).....	(1)	\$630,000	(1)	\$700,000	(1)	\$800,000
Coal (sold or shipped by producers).....	2,387,192	6,777,351	2,837,347	8,954,354	2,934,000	9,538,000
Gypsum (crude).....	243,545	3,321,652	(1)	(1)	(1)	(1)
Lime.....	22,806	3,056,004	19,733	2,959,950	13,944	2,231,040
Lead.....	(1)	(1)	(1)	(1)	(1)	(1)
Manganese ore.....	31	(1)	265	(1)	(1)	(1)
Natural gas.....	(1)	(1)	(1)	(1)	(1)	(1)
Natural gasoline and allied products.....	269,704,000	38,270,000	285,045,000	42,503,000	315,000,000	47,880,000
Natural gas.....	336,707,000	12,655,000	399,942,000	15,663,000	301,246,000	17,200,000
Purified petroleum gases.....	108,408,000	2,853,000	112,371,000	2,858,000	120,522,000	3,400,000
Ores (crude), etc.:.....						
Lead.....	3,316,888	(1)	9,785,962	(1)	9,908,605	(1)
Zinc.....	9,481,535	(1)	3,874,225	(1)	3,703,111	(1)
Zinc-lead.....	140,690,000	168,000,000	123,152,000	146,550,000	124,616,000	153,100,000
Pumice.....	(1)	(1)	(1)	(1)	(1)	(1)
Salt.....	8,305	35,132	7,716	30,498	(1)	(1)
Sand and gravel.....	3,109,630	1,046,644	2,141,705	1,191,929	1,364,604	746,207
Stone.....	5,940,620	3,172,547	6,169,750	3,205,329	4,563,270	1,799,765
Sulfuric acid.....	(1)	(1)	(1)	(1)	(1)	(1)
Tripoli.....	(1)	(1)	(1)	(1)	(1)	(1)
Zinc.....	146,510	27,250,800	114,085	24,642,380	91,440	20,850,372
Miscellaneous.....		6,770,356		5,852,014		3,606,355
Total value, eliminating duplications.....		271,298,469		254,642,000		280,576,000

1 Not valued as ore; value of recoverable metal content included under the metals.

2 From zinc smelting.

3 Value not included in total value for State.

4 Includes minerals indicated by "1" above.

1 Value included under "Miscellaneous."

2 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

3 No canvass.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Aluminum.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Antimony ore (concentrates).....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Asbestos.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Barite.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Bismuth.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Chromite.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Clay.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Products (other than pottery and refractories).....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Flint.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
For (sold or shipped by producers).....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Coal.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Copper.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Diatomite.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Ferro-alloys.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Gems and precious stones.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Gold.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Lead.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Lime.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Manganese ore.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Mercury.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Ores (crude), etc.:.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Copper.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Dry and siliceous (gold and silver).....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Platinum metals (crude).....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Pumice.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Silica (quartz).....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Silver.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Stone.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Miscellaneous.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Total value, eliminating duplications.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)

1 Value included under "Miscellaneous."

2 Value not included in total value for State.

3 Figures not available.

4 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

5 No canvass.

6 Not valued as ore; value of recoverable metal content included under the metals.

7 "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."

8 Includes minerals indicated by "u" and "n" above.

9 Value of "Government-and-contractor" included under "Miscellaneous."

10 Includes minerals indicated by "u" and "n" above.

11 Value of "Government-and-contractor" included under "Miscellaneous."

12 Includes minerals indicated by "u" and "n" above.

13 Value of "Government-and-contractor" included under "Miscellaneous."

14 Includes minerals indicated by "u" and "n" above.

15 Value of "Government-and-contractor" included under "Miscellaneous."

16 Includes minerals indicated by "u" and "n" above.

17 Value of "Government-and-contractor" included under "Miscellaneous."

18 Includes minerals indicated by "u" and "n" above.

19 Value of "Government-and-contractor" included under "Miscellaneous."

20 Includes minerals indicated by "u" and "n" above.

21 Value of "Government-and-contractor" included under "Miscellaneous."

22 Includes minerals indicated by "u" and "n" above.

23 Value of "Government-and-contractor" included under "Miscellaneous."

24 Includes minerals indicated by "u" and "n" above.

25 Value of "Government-and-contractor" included under "Miscellaneous."

26 Includes minerals indicated by "u" and "n" above.

27 Value of "Government-and-contractor" included under "Miscellaneous."

28 Includes minerals indicated by "u" and "n" above.

29 Value of "Government-and-contractor" included under "Miscellaneous."

30 Includes minerals indicated by "u" and "n" above.

31 Value of "Government-and-contractor" included under "Miscellaneous."

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33 Value of "Government-and-contractor" included under "Miscellaneous."

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45 Value of "Government-and-contractor" included under "Miscellaneous."

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49 Value of "Government-and-contractor" included under "Miscellaneous."

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55 Value of "Government-and-contractor" included under "Miscellaneous."

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57 Value of "Government-and-contractor" included under "Miscellaneous."

58 Includes minerals indicated by "u" and "n" above.

59 Value of "Government-and-contractor" included under "Miscellaneous."

60 Includes minerals indicated by "u" and "n" above.

61 Value of "Government-and-contractor" included under "Miscellaneous."

62 Includes minerals indicated by "u" and "n" above.

63 Value of "Government-and-contractor" included under "Miscellaneous."

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65 Value of "Government-and-contractor" included under "Miscellaneous."

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95 Value of "Government-and-contractor" included under "Miscellaneous."

96 Includes minerals indicated by "u" and "n" above.

97 Value of "Government-and-contractor" included under "Miscellaneous."

98 Includes minerals indicated by "u" and "n" above.

99 Value of "Government-and-contractor" included under "Miscellaneous."

100 Includes minerals indicated by "u" and "n" above.

Mineral products of the United States, 1948-44, by States—Continued
PENNSYLVANIA

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement.....	1 33,639,025	1 \$46,377,469	1 19,551,388	1 \$27,907,236	1 13,918,172	1 \$20,089,765
Clay:.....						
Products (other than pottery and refractories).....						
Raw (sold or shipped by producers).....						
barrels.....		2 9,400,000		2 7,000,000		2 6,000,000
short tons.....	1,279,398	3,223,172	1,250,735	3,227,363	989,035	2,712,458
Coal:.....						
Anthracite.....						
do.....	60,327,729	271,673,000	60,643,620	306,816,018	63,701,363	354,582,884
Bituminous.....	144,073,189	356,877,215	141,049,814	397,634,020	148,800,000	464,256,000
pounds.....	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)
Cobalt.....	23,619,504	118,557,069	23,453,317	135,887,231	23,147,471	144,654,808
short tons.....	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)
Copper.....	656,637	118,257,164	662,206	117,243,191	692,781	110,626,554
long tons.....	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)
Feldspar (crude).....						
short tons.....	2,499	87,465	2,218	77,630	2,115	74,025
Gems and precious stones.....						
do.....						
Gold.....						
troy ounces.....						
Graphite, crystalline.....						
pounds.....						
Iron:.....						
Ore.....						
long tons.....	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)
short tons.....	18,038,237	388,006,953	18,593,220	399,568,279	18,503,427	397,395,665
Lime.....	1,030,156	7,708,095	1,021,215	7,864,323	1,026,292	7,933,361
Manganese ore.....	22	(⁽¹⁾)				
Mica:.....						
do.....	(⁽¹⁾)	(⁽¹⁾)	(⁽¹⁾)	22	(⁽¹⁾)	(⁽¹⁾)
Scrap.....						
Sheet.....						
Mineral paints (zinc and lead pigments).....						
Mineral waters.....						
Natural gas.....						
Natural gasoline and allied products:.....						
Natural gasoline.....	93,532,000	44,783,000	93,543,000	45,272,000	92,000,000	45,080,000
Liquefied petroleum gases.....						
gallons.....	14,876,000	712,000	17,084,000	893,000	17,023,000	990,000
do.....	418,000	37,000	450,000	40,000	472,000	42,000
Petroleum.....	3,434	9,061	5,790	14,925	6,750	20,894
Pyrites.....	17,779,000	52,250,000	15,757,000	46,960,000	14,118,000	46,600,000
Sand and gravel.....						
Sand and sandstone (ground).....	10,614,411	10,700,743	9,279,469	9,251,344	6,919,406	7,265,943
Silica (quartz).....						
Silver.....						
Slate.....	15,501	11,023	13,095	9,312	13,545	9,632
Soapstone.....		2,606,799	(⁽¹⁾)	1,836,925	(⁽¹⁾)	1,827,896
Stone.....	23,131,670	25,892,960	19,998,570	22,566,298	18,176,280	22,516,282

Product sold (no. quantity)	1942	1943	1944	1945	1946	1947	1948	1949	1950
Barite									
Clay									
Products (other than pottery and refractories)									
Raw (sold or shipped by producers)									
Copper									
Corundum									
Ferro-alloys									
Gems and precious stones									
Gold									
Manganese ore									
Manganese ore									
Mica									
Strap									
Sheet									
See footnotes at end of State table.									

1 Exclusive of natural cement, value for which is included under "Miscellaneous."
 2 Exclusive of dimension basalt in 1942 and 1943 and of crushed granite in 1944, value for which is included under "Miscellaneous."
 3 From zinc smelting.
 4 Includes minerals indicated by "i," "o," and "p" above.

1 Exclusive of natural cement, value for which is included under "Miscellaneous."
 2 Exclusive of dimension basalt in 1942 and 1943 and of crushed granite in 1944, value for which is included under "Miscellaneous."
 3 From zinc smelting.
 4 Includes minerals indicated by "i," "o," and "p" above.

RHODE ISLAND

Clay products (other than pottery and refractories)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Coke	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Graphite, amorphous	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Lime	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel	572,437	331,881	356,043	337,750	352,905	237,112	237,112
Stone	191,420	331,064	171,220	410,478	10,790	213,351	213,351
Miscellaneous		2,555,107		2,552,906		2,694,814	2,694,814
Total value, eliminating duplications		836,040		808,000		612,000	612,000

1 Value included under "Miscellaneous."
 2 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
 3 Value not included in total value for State.

SOUTH CAROLINA

Barite	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Clay	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Products (other than pottery and refractories)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Raw (sold or shipped by producers)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Copper	118,055	\$1,600,000	116,458	\$1,200,000	140,883	\$1,100,000	\$1,100,000
Corundum	1,000	970,669	1,000	965,153		1,111,884	1,111,884
Ferro-alloys	(1)	121	(1)	130	(1)	(1)	(1)
Gems and precious stones	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Gold	7,824	273,840	147	5,145	1,484	(1)	(1)
Manganese ore			312	(1)	171	(1)	(1)
Manganese ore			156	(1)		(1)	(1)
Mica	507	7,620	5	100			
Strap	2,904	400	573	1,067			
Sheet							
See footnotes at end of State table.							

Mineral products of the United States, 1942-44, by States—Continued

SOUTH CAROLINA—Continued

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Mineral waters.....	(¹) 86,270	(¹)	(¹) 156	(¹)	(¹)	(¹)
Ore (dry and siliceous) (gold and silver).....	729,543	\$353,170	452,166	\$217,280	269,743	\$190,114
Sand and gravel.....	5,064	3,601	135	86		
Silver.....	2,040,610	2,624,234	1,615,730	1,804,196	1,195,900	1,717,295
Stone.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Topaz, industrial.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Vermiculite.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Miscellaneous ²		4,355,801		4,041,855		2,736,985
Total value, eliminating duplications.....		5,890,982		4,759,000		4,192,000

¹ Value included under "Miscellaneous."² Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.³ Value not included in total value for State.⁴ No canvas.⁵ Not valued as ore; value of recoverable metal content included under the metals.⁶ Exclusive of dimension granite, value for which is included under "Miscellaneous."⁷ Includes minerals indicated by "1" and "4" above.

SOUTH DAKOTA

Beryllium ore.....	205	\$18,148	238	\$28,843	308	\$44,565
Cement.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Clay.....						
Products (other than pottery and refractories).....						
Raw (sold or shipped by producers).....	88,149	664,449	124,528	822,284	169,893	1,104,919
Coal.....	53,538	104,000	40,664	78,000	30,000	46,000
Copper.....	2,000	242			2,000	28,270
Feldspar (crude).....	64,842	225,410	70,913	342,643	64,806	288,188
Gems and precious stones.....						
Gold.....	522,098	18,273,430	106,444	3,725,540	11,621	406,735
Gypsum (crude).....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Iron ore sold for paint.....	85	11,390	1,678	6,150	1,038	5,440
Lime.....	4,964	189,182	5,452	200,194	34	172,421
Lithium minerals.....	81	(¹)	12	(¹)	(¹)	(¹)
Manganese ore.....						
Mica.....	2,545	44,079	2,224	42,764	2,558	51,405
Scrap.....	396,224	75,687	333,424	447,209	146,383	472,026
Sheet.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Mineral waters.....						
Natural gas.....	7,000	2,000	6,000	2,000	7,000	2,000

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WASHINGTON, D. C. 20540

Ores (copper, silver, zinc and siliceous (gold and silver))	short tons	1,404,387	(1)	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911	2912	2913	2914	2915	2916	2917	2918	2919	2920	2921	2922	2923	2924	2925	2926	2927	2928	2929	2930	2931	2932	2933	2934	2935	2936	2937	2938	2939	2940	2941	2942	2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Value included under "Miscellaneous."
 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
 No canvases.

TENNESSEE

[illegible]

See footnotes at end of State table.

Mineral products of the United States, 1942-44, by States—Continued

TENNESSEE—Continued

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Pyrites.....long tons.	(1)	\$3,650,427	(1)	2,922,762	(1)	2,794,167
Sand and gravel.....short tons.	(1)	\$2,064,490	(1)	\$2,285,339	(1)	\$2,314,478
Silica (quartz).....do.	(1)	34,671	(1)	37,019	(1)	45,907
Silver.....troy ounces.	(1)	7,716,540	(1)	8,280,320	(1)	7,776,776
Stones.....do.	(1)	9,018,272	(1)	10,047,944	(1)	32,645
Strontium minerals.....do.	(1)	43,971	(1)	41,766	(1)	40,881
Sulfuric acid.....do.	(1)	8,178,606	(1)	9,021,456	(1)	9,309,468
Zinc.....do.	(1)	60,170,344	(1)	64,836,623	(1)	54,324,215
Miscellaneous.....do.	(1)	67,228,639	(1)	64,465,000	(1)	63,282,000
Total value, eliminating duplications.....						

* Value included under "Miscellaneous."

* Value not included in total value for State.

* Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

* No canvass.

* Not valued as ore; value of recoverable metal content included under the metals.

* "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
 * Exclusive of crushed sandstone, value for which is included under "Miscellaneous."
 * From copper smelting.
 * Includes minerals indicated by "i," "a," and "r" above.

TEXAS

Asphalt (native).....	(1)	\$20,942,867	(1)	\$15,635,708	(1)	\$11,138,166
Bromine.....	(1)	12,136,800	(1)	9,177,392	(1)	9,261,931
Cement.....	(1)	203,355	(1)	182,407	(1)	147,669
Chromite.....	(1)	203,355	(1)	182,407	(1)	147,669
Clay.....	(1)	13,210	(1)	9,097	(1)	130,000
Coal.....	(1)	280,969	(1)	144,144	(1)	184,506
Products (other than pottery and refractories).....	(1)	23,968	(1)	21,060	(1)	31,060
Raw (sold or shipped by producers).....	(1)	198,000	(1)	19,281	(1)	100,381
Bituminous.....do.	(1)	55,076	(1)	940	(1)	4,769
Lignite.....do.	(1)	246,000	(1)	728,141	(1)	916,169
Coke.....do.	(1)	13,210	(1)	140	(1)	
Copper.....do.	(1)	13,210	(1)	140	(1)	
Feldspar (crude).....pounds.	(1)	198,000	(1)	19,281	(1)	100,381
Fluorspar.....long tons.	(1)	198,000	(1)	19,281	(1)	100,381
Fuller's earth.....short tons.	(1)	198,000	(1)	19,281	(1)	100,381
Gems and precious stones.....do.	(1)	198,000	(1)	19,281	(1)	100,381
Gold.....troy ounces.	(1)	198,000	(1)	19,281	(1)	100,381

	C ¹ (c)	C ² (c)	C ³ (c)	C ⁴ (c)	C ⁵ (c)	C ⁶ (c)	C ⁷ (c)	C ⁸ (c)	C ⁹ (c)	C ¹⁰ (c)
Graphite, crystalline.....	181	24,254	559,279	13	7,394	1,050	94,923	757,064	325,323	
Graphite, amorphous.....	67,377	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Iron.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Lead.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Lime.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Magnesia.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Magnesium.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Magnesium compounds (natural).....	142	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Manganese.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Mercury.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Mica.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Scrap.....	45	10	(1)	42	770	1,095	1,095	129,604	129,604	
Sheet.....	(1)	(1)	(1)	31	157	(1)	(1)	(1)	(1)	
Mineral waters.....	1,170,345,000	182,660,000	1,323,885,000	1,323,885,000	199,559,000	1,460,000,000	1,460,000,000	219,000,000	219,000,000	
Natural gas.....	1,207,901,000	43,472,000	1,251,373,000	1,251,373,000	52,775,000	1,325,801,000	1,325,801,000	64,149,000	64,149,000	
Natural gasoline and allied products:	339,924,000	6,832,000	346,756,000	346,756,000	10,387,000	357,143,000	357,143,000	14,765,000	14,765,000	
Natural gasoline and cycle products.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Liquefied petroleum gases.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Ores (crude), etc.:										
Copper.....	596	(1)	(1)	339	(1)	(1)	(1)	(1)	(1)	
Dry and siliceous (gold and silver).....	100,052	(1)	(1)	3,040	(1)	(1)	(1)	(1)	(1)	
Lead.....	140	(1)	(1)	155	(1)	(1)	(1)	(1)	(1)	
Pebbles for grinding.....	(1)	(1)	(1)	5,341	(1)	(1)	(1)	(1)	(1)	
Petroleum.....	483,097,000	564,400,000	1,047,497,000	594,343,000	717,600,000	1,262,100,000	1,262,100,000	903,200,000	903,200,000	
Pumice.....	821,111	2,202,527	3,023,638	1,127,854	3,610,532	4,634,169	4,634,169	3,627,528	3,627,528	
Salt (sodium chloride).....	17,727,971	11,039,412	28,767,383	12,679,989	8,523,820	37,297,372	37,297,372	6,424,132	6,424,132	
Sand and gravel.....	319	3,190	3,509	(1)	(1)	(1)	(1)	(1)	(1)	
Silica (quartz).....	672,781	478,422	1,151,203	10,284	7,313	5,355	5,355	3,808	3,808	
Silver.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Soapstone.....	75,032	1,008,286	1,083,318	(1)	(1)	(1)	(1)	(1)	(1)	
Sodium sulfate (natural).....	3,772,040	3,658,802	7,430,842	2,698,220	2,534,271	5,225,113	5,225,113	7,455,791	7,455,791	
Stone.....	1,917	19,185	21,102	4,938	62,137	83,242	83,242	45,991,648	45,991,648	
Strontium minerals.....	2,579,739	41,275,824	43,855,563	2,385,909	38,174,544	40,560,453	40,560,453	7,750	7,750	
Sulfur.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Sulfuric acid.....	1,500	15,000	16,500	2,500	25,000	26,500	26,500	1,550	1,550	
Sulfur ore.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Tungsten ore (60-percent concentrates).....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Vermiculite.....	(1)	(1)	(1)	199	1,990	2,189	2,189	34,972,659	34,972,659	
Miscellaneous.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
Total value, eliminating duplications.....		909,203,286	1,008,286	1,103,390,000	1,103,390,000	1,319,378,000	1,319,378,000	1,319,378,000	1,319,378,000	

† Not valued as ore; value of recoverable metal content included under the metals.
 ‡ Exclusive of basalt and dimension unclassified stone, value for which is included under "Miscellaneous."
 § From zinc smelting.
 ¶ Includes minerals indicated by "q" and "r" above.
 * Value included under "Miscellaneous."
 † Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
 ‡ Value not included in total value for State.
 § No canvass.
 ¶ Figures cover fiscal year ended June 30 of year stated.

Mineral products of the United States, 1942-44, by States—Continued

UTAH

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Antimony ore (concentrates).....	(1)	(1)	(1)	\$406	5	\$371
Arsenious oxide.....	(1)	(1)	(1)	(1)	(1)	(1)
Asphalt (native).....	40,078	\$912,163	76,987	1,390,485	(1)	(1)
Bismuth.....	(1)	(1)	(1)	(1)	(1)	(1)
Bitumen, natural sulfonated.....	(1)	(1)	(1)	(1)	(1)	(1)
Cement.....	(1)	(1)	(1)	(1)	(1)	(1)
Clay.....	(1)	(1)	(1)	(1)	(1)	(1)
Products (other than pottery and refractories)						
Raw (sold or shipped by producers)						
Coal.....	29,359	\$1,000,000	17,905	\$1,000,000	26,152	(1)
do.....	5,516,849	57,395	6,665,936	43,465	7,120,000	65,208
Coke.....	264,933	14,271,221	324,829	19,977,743	760,874	22,784,000
Copper.....	613,382,000	74,219,222	647,978,000	84,237,140	565,150,000	76,295,250
Fluorspar.....	(1)	(1)	(1)	(1)	(1)	(1)
Fuller's earth.....	1,018	(1)	51	(1)	3,466	(1)
Gems and precious stones.....	(1)	(1)	(1)	(1)	(1)	(1)
Gold.....	391,544	13,704,040	390,470	13,666,450	344,223	12,047,805
Gypsum (crude).....	48,574	60,259	(1)	(1)	(1)	(1)
Iron.....	(1)	(1)	(1)	(1)	(1)	(1)
Ore.....	319,834	(1)	911,839	(1)	1,540,594	1,742,876
Pig.....	(1)	(1)	(1)	(1)	(1)	(1)
Lead.....	71,930	9,638,620	65,267	9,788,550	52,519	8,403,040
Lime.....	57,609	392,912	59,811	407,753	51,202	379,550
Manganese ore.....	790	21,650	91	3,083	30	(1)
Manganiferous ore.....	78	(1)	18	(1)	32,141	(1)
Mercury.....	(1)	(1)	(1)	(1)	(1)	(1)
Molybdenum.....	(1)	(1)	(1)	(1)	(1)	(1)
Natural gas.....	5,163,000	1,079,000	4,464,000	962,000	6,800,000	1,428,000
Natural gasoline.....	5,775,000	39,000	666,000	35,000	(1)	(1)
Ores (crude), etc.:						
Copper.....	33,611,061	(1)	35,990,656	(1)	29,930,659	(1)
Dry and siliceous (gold and silver)	434,234	(1)	352,475	(1)	241,337	(1)
Lead.....	75,758	(1)	48,658	(1)	15,926	(1)
Lead-copper.....	41	(1)	53	(1)	(1)	(1)
Zinc.....	16,710	(1)	231,845	(1)	95,968	(1)
Zinc-lead.....	841,837	(1)	753,930	(1)	656,065	(1)
Zinc-lead-copper.....	2,014	(1)	114	(1)	250	(1)
Phosphate rock.....	1,184	7,410	(1)	(1)	(1)	(1)
Potassium salts.....	117,274	340,125	109,810	562,293	119,809	368,500
Salt (sodium chloride).....	110,871	290,040	(1)	(1)	(1)	(1)

ball (sodium carbonate)..... short tons..... 17,274
do..... do..... 110,871
340,125
240,040
190,810
502,293
119,909

Value added in mining	Value added in manufacturing	Value added in transportation	Value added in commerce	Value added in other services	Value added in miscellaneous	Total value, eliminating duplications
1,075,500	1,075,500	1,075,500	1,075,500	1,075,500	1,075,500	1,075,500
45,543	45,543	45,543	45,543	45,543	45,543	45,543
140,988,512	140,988,512	140,988,512	140,988,512	140,988,512	140,988,512	140,988,512
164,150,000	164,150,000	164,150,000	164,150,000	164,150,000	164,150,000	164,150,000
160,153,000	160,153,000	160,153,000	160,153,000	160,153,000	160,153,000	160,153,000

Total value, eliminating duplications..... 164,150,000

1 Value included under "Miscellaneous."
2 Figures of Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
3 Value not included in total value for State.
4 No canvass.

VERMONT

Arsenious oxide.....	short tons.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Asbestos.....	do.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Clay.....	do.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Products (other than pottery and refractories)	do.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Raw (sold or shipped by producers)	do.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Copper.....	short tons.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Gold.....	short tons.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Lime.....	short tons.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Mica, scrap.....	short tons.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters.....	do.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Ores (crude), etc.: Copper.....	short tons.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel.....	do.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Silver.....	do.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Slate.....	do.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Stone.....	do.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Talc.....	do.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Miscellaneous.....	do.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Total value, eliminating duplications.....	do.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)

1 Figures not available.
2 Value included under "Miscellaneous."
3 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
4 No canvass.
5 Not valued as ore; value of recoverable metal content included under the metals.
6 Includes minerals indicated by "1" and "9" above.

Mineral products of the United States, 1943-44, by States—Continued
VIRGINIA

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Applite (crude).....	(1)	(1)	(1)	(1)	(1)	(1)
Barite.....	(1)	(1)	(1)	(1)	(1)	(1)
Bauxite.....	(1)	(1)	(1)	(1)	(1)	(1)
Beryllium ore.....	(1)	(1)	(1)	(1)	(1)	(1)
Cement.....	(1)	(1)	(1)	(1)	(1)	(1)
Clay.....	(1)	(1)	(1)	(1)	(1)	(1)
Products (other than pottery and refractories)						
Raw (sold or shipped by producers)		\$ 2,500,000		\$ 1,600,000		\$ 1,200,000
Coal.....	(1)	(1)	(1)	(1)	(1)	(1)
136,179.....	20,	52,079,249	20,	59,923,217	19,900,000	64,476,000
Coke.....	350,521	\$ 2,281,289	293,324	\$ 2,051,662	243,116	\$ 1,895,243
Copper.....	55,000	6,655	200,000	26,000	582,000	78,570
Feldspar (crude).....	24,298	140,304	(1)	122,957	24,010	147,106
Ferro-alloys.....	(1)	(1)	(1)	(1)	(1)	(1)
Gems and precious stones.....	(1)	(1)	(1)	(1)	(1)	(1)
Gold.....	109	3,815	50	1,750	132	4,620
Gypsum (crude).....	(1)	(1)	(1)	(1)	(1)	(1)
Iron.....	(1)	(1)	(1)	(1)	(1)	(1)
Ore.....	10,174	(1)	7,490	(1)	6,716	(1)
Fig.....	(1)	(1)	(1)	(1)	(1)	(1)
Kyanite.....	5,592	116,683	(1)	(1)	(1)	(1)
Lead.....	1,803	241,602	(1)	(1)	(1)	(1)
Lime.....	206,420	1,367,043	2,288	343,200	4,622	739,520
Manganese ore.....	11,246	246,251	194,974	1,338,675	154,160	1,129,342
Manganiferous ore.....	3,905	18,752	7,040	238,435	20,172	623,080
Marl, calcareous.....	25,752	27,528	12,208	73,451	4,419	84,207
Mica.....	(1)	(1)	61,724	73,698	68,707	(1)
Scrap.....	2,019	29,519	1,499	31,529	1,700	38,294
Sheet.....	4,529	1,581	5,829	15,863	15,082	57,906
Millstones.....	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters.....	(1)	(1)	(1)	(1)	(1)	(1)
Natural gas.....	(1)	(1)	(1)	(1)	(1)	(1)
Ores (crude), etc.:						
Copper.....	92,000	86,000	77,000	74,000	55,000	53,000
Dry and siliceous (gold and silver)	(1)	(1)	(1)	(1)	(1)	(1)
Zinc.....	46	(1)	35	(1)	1,925	(1)
Zinc-lead.....	100	(1)	528,016	(1)	528,688	(1)
Petroleum.....	708	(1)	2,000	5,000	3,000	(1)
Phosphate rock.....	462,127	(1)	(1)	(1)	(1)	(1)
Pyrites.....	(1)	(1)	(1)	(1)	(1)	(1)
Quartz crystal.....	(1)	(1)	(1)	(1)	(1)	(1)
Salt.....	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel.....	5,610,753	5,460,232	4,668,708	4,775,935	3,247,670	3,328,645
Sand and sandstone (ground).....	(1)	(1)	(1)	(1)	(1)	(1)
Silica (quartz).....	(1)	(1)	(1)	(1)	(1)	(1)
Silver.....	1,793	1,275	14,947	10,690	75	303

* Not valued as ore; value of recoverable metal content included under the metals.

* Estimated by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.
 † Scrapstone used as dimension stone included in figures for stone.
 ‡ Includes minerals indicated by "i" above.

WASHINGTON

Total value, eliminating duplications.		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Aluminum.....	short tons.....								
Antimony ore (concentrates).....	do.....		5						
Arsenious oxide.....	do.....		(1)						
Cement.....	barrels.....		(1)						
Chromite.....	short tons.....		57						
Clay.....	short tons.....								
Products (other than pottery and refractories).....	short tons.....								
Raw (sold or shipped by producers).....	short tons.....								
Coal.....	short tons.....		84,966						
Coke.....	do.....		1,933,209						
Diatomite.....	do.....								
Copper.....	short tons.....		16,090,000						
Ferro-alloys.....	short tons.....		(1)						
Fluorspar.....	do.....		(1)						
Gems and precious stones.....	do.....		48						
Gold.....	tray ounces.....		75,396						
Iron ore.....	long tons.....		11,851						
Lead.....	short tons.....		4,851						
Lime.....	do.....		55,864						
Magnesite.....	do.....		(1)						
Magnesium.....	do.....		(1)						
Magnesium sulfate (natural).....	pounds.....		10,660						
Manganese ore.....	short tons.....		(1)						
Mercury.....	flasks (76 pounds).....		(1)						
Mineral waters.....	gallons sold.....		(1)						
Ores (crude), etc.:.....	short tons.....		717,124						
Copper.....	do.....		93,957						
Dry and siliceous (gold and silver).....	do.....		161						
Lead.....	do.....		5						
Lead-copper.....	do.....								
Zinc.....	do.....								
Zinc-copper.....	do.....								
Zinc-lead.....	do.....		411,690						

See footnotes at end of State tables

Mineral products of the United States, 1942-44, by States—Continued

WASHINGTON—Continued

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Peat.....	(1)	(1)	(1)	(1)	(1)	(1)
Pebbles for grinding.....	194	\$9,985	63	\$4,148	(1)	(1)
Pulping stones.....	do.	do.	700	7,362	(1)	(1)
Pumice.....	do.	do.	(1)	(1)	783	\$8,705
Quartz crystal.....	8,172,550	4,094,900	7	3,403,720	(3)	6,946,133
Sand and gravel.....	(1)	(1)	5,183,374	25,485	(1)	4,076,976
Sand and sandstone (ground).....	(1)	(1)	3,902	(1)	(1)	(1)
Silica (quartz).....	399,038	292,427	(1)	263,424	(1)	228,699
Silver.....	(1)	(1)	370,440	(1)	321,608	(1)
Sodium sulfate (natural).....	(1)	(1)	(1)	(1)	(1)	(1)
Stone.....	1,965,820	1,894,757	2,081,810	2,499,550	2,538,690	\$2,756,332
Strontium minerals.....	7	2,864	1,998	11,822	3,288	34,103
Tale and ground soapstone.....	43	56,280	4	6,712	5	(1)
Tungsten ore (90-percent concentrates).....	14,398	2,678,028	12,203	2,635,848	11,904	2,714,112
Zinc.....	do.	56,393,496	do.	83,762,789	do.	82,244,887
Miscellaneous ¹	do.	do.	do.	do.	do.	do.
Total value, eliminating duplications.....	do.	35,659,543	do.	37,563,000	do.	36,320,000

¹ Value included under "Miscellaneous."² Value not included in total value for State.³ Figures not available.⁴ Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.⁵ No canvas.

⁶ Not valued as ore; value of recoverable metal content included under the metals.
⁷ "Commercial." Value of "Government-and-contractor" included under "Miscellaneous."
⁸ Exclusive of marble, value for which is included under "Miscellaneous."
⁹ Includes minerals indicated by "a," "b," "c," and "d," above.

WEST VIRGINIA

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Bromine.....	(1)	(1)	1,002,908	\$95,391	(1)	(1)
Calcium chloride.....	(1)	(1)	16,144	53,244	(1)	\$52,506
Cement.....	(1)	(1)	(1)	(1)	(1)	(1)
Clay.....	do.	do.	do.	do.	do.	do.
Products (other than pottery and refractories).....	do.	do.	do.	do.	do.	do.
Raw (sold or shipped by producers).....	do.	do.	do.	do.	do.	do.
Coal.....	74,141	\$2,000,000	72,529	\$1,400,000	68,898	\$1,000,000
Coke.....	155,881,497	146,245	158,904,309	140,286	163,845,000	134,312
Ferro-alloys.....	2,776,590	377,472,975	3,035,376	444,026,660	3,016,548	503,004,000
Grindstones and pulpstones.....	162,699	\$11,166,657	167,621	\$13,513,440	(1)	\$14,255,640
Iron, pig.....	1,957	\$22,807,398	2,172	\$26,801,660	(1)	(1)
Lime.....	1,417,225	113,968	1,335,331	102,098	1,355,784	(1)
Magnetite.....	422,481	(1)	492,292	(1)	493,724	(1)
Magnesium chloride (natural).....	do.	do.	do.	do.	do.	do.
Manganese ore.....	2,240	2,879,509	do.	3,401,706	do.	3,464,019
Manganiferous ore.....	560	(1)	do.	do.	do.	do.

Mineral product	1916, 1917, 1918	1919, 1920, 1921	1922, 1923, 1924	1925, 1926, 1927	1928, 1929, 1930	1931, 1932, 1933
Natural gas, including shale gas	57, 487, 188	2, 817, 181	59, 041, 181	7, 300, 181	7, 300, 181	7, 300, 181
Oil shale	3, 074, 181	1, 848, 181	32, 291, 181	3, 300, 181	3, 300, 181	3, 300, 181
Oil shale gas	3, 074, 181	1, 848, 181	32, 291, 181	3, 300, 181	3, 300, 181	3, 300, 181
Sand and gravel	140, 216	140, 216	140, 216	140, 216	140, 216	140, 216
Sand and sandstone (ground)	140, 216	140, 216	140, 216	140, 216	140, 216	140, 216
Sandstone	140, 216	140, 216	140, 216	140, 216	140, 216	140, 216
Sulfuric acid	223, 330	223, 330	223, 330	223, 330	223, 330	223, 330
Miscellaneous	223, 330	223, 330	223, 330	223, 330	223, 330	223, 330
Total value, eliminating duplications	493, 994, 030	493, 994, 030	493, 994, 030	493, 994, 030	493, 994, 030	493, 994, 030

1 Value included under "Miscellaneous."	2 Exclusive of dimension limestone, value for which is included under "Miscellaneous."
3 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.	4 From zinc smelting.
5 Value not included in total value for State.	6 Includes minerals indicated by "i" and "a" above.

WISCONSIN

Mineral product	1916, 1917, 1918	1919, 1920, 1921	1922, 1923, 1924	1925, 1926, 1927	1928, 1929, 1930	1931, 1932, 1933
Cement	(i)	(i)	(i)	(i)	(i)	(i)
Clay	(i)	(i)	(i)	(i)	(i)	(i)
Products (other than pottery and refractories)	(i)	(i)	(i)	(i)	(i)	(i)
Raw (solid or shipped by producers)	(i)	(i)	(i)	(i)	(i)	(i)
Coke	(i)	(i)	(i)	(i)	(i)	(i)
Flint lining for tube mills	(i)	(i)	(i)	(i)	(i)	(i)
Iron ore	(i)	(i)	(i)	(i)	(i)	(i)
Lead	(i)	(i)	(i)	(i)	(i)	(i)
Lime	(i)	(i)	(i)	(i)	(i)	(i)
Marl, calcareous	(i)	(i)	(i)	(i)	(i)	(i)
Mineral waters	(i)	(i)	(i)	(i)	(i)	(i)
Ores (crude), etc.	(i)	(i)	(i)	(i)	(i)	(i)
Zinc	(i)	(i)	(i)	(i)	(i)	(i)
Zinc-lead	(i)	(i)	(i)	(i)	(i)	(i)
Peat	(i)	(i)	(i)	(i)	(i)	(i)
Pebbles for grinding	(i)	(i)	(i)	(i)	(i)	(i)
Pyrites	(i)	(i)	(i)	(i)	(i)	(i)
Sand and gravel	(i)	(i)	(i)	(i)	(i)	(i)
Sand and sandstone (ground)	(i)	(i)	(i)	(i)	(i)	(i)
Silica (quartz)	(i)	(i)	(i)	(i)	(i)	(i)
Stone	(i)	(i)	(i)	(i)	(i)	(i)
Zinc	(i)	(i)	(i)	(i)	(i)	(i)
Miscellaneous	(i)	(i)	(i)	(i)	(i)	(i)
Total value, eliminating duplications	17, 998, 036	17, 998, 036	17, 998, 036	17, 998, 036	17, 998, 036	17, 998, 036

1 Value included under "Miscellaneous."	2 Exclusive of dimension limestone, value for which is included under "Miscellaneous."
3 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.	4 From zinc smelting.
5 Value not included in total value for State.	6 Includes minerals indicated by "i" and "a" above.

Mineral products of the United States, 1942-44, by States—Continued

WYOMING

Product	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement.....	(1)	(1)	(1)	(1)	(1)	(1)
Clay.....	(1)	(1)	(1)	(1)	(1)	(1)
Products (other than pottery and refractories).....	139,410	\$1,259,863	159,252	\$1,389,644	196,138	\$1,711,193
Raw (sold or shipped by producers).....	8,133,225	17,927,061	9,155,123	21,807,231	9,665,000	25,322,040
Coal.....	13,963	50,730	(1)	(1)	22,415	81,770
Fluorspar (crude).....	(1)	(1)	(1)	(1)	19	400
Gold.....	23	805	(1)	(1)	(1)	(1)
Gems and precious stones.....	(1)	(1)	(1)	(1)	(1)	(1)
Gypsum (crude).....	957,027	402	814,203	(1)	713,759	(1)
Iron ore.....	3	(1)	(1)	(1)	(1)	(1)
Lead.....	(1)	(1)	(1)	(1)	(1)	(1)
Manganese ore.....	(1)	(1)	(1)	(1)	(1)	(1)
Mica.....	(1)	(1)	(1)	(1)	(1)	(1)
Scrap.....	(1)	(1)	(1)	(1)	(1)	(1)
Sheet.....	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters.....	(1)	(1)	(1)	(1)	(1)	(1)
Natural gas.....	33,124,000	6,507,000	34,351,000	6,942,000	37,000,000	7,548,000
Natural gasoline and allied products.....	32,699,000	1,636,000	32,358,000	1,698,000	33,181,000	1,962,000
Natural gasoline.....	2,538,000	104,000	3,117,000	141,000	15,699,000	710,000
Liquid petroleum gases.....	(1)	(1)	(1)	(1)	(1)	(1)
Ores (crude), etc.....	59	(1)	(1)	(1)	(1)	(1)
Dry and siliceous (gold and silver).....	25	(1)	(1)	(1)	(1)	(1)
Lead.....	32,812,000	29,000,000	34,253,000	33,570,000	32,388,000	32,400,000
Petroleum.....	3,975,673	1,613,407	2,224,941	33,978,480	1,460,663	720,381
Sand and gravel.....	9,214	94,308	(1)	(1)	(1)	(1)
Silver.....	179,240	207,122	259,360	197,641	396,660	383,463
Sodium salts (carbonates and sulfates) (natural).....	1,060	5,659,312	(1)	(1)	(1)	(1)
Stone.....	(1)	(1)	(1)	(1)	(1)	(1)
Vermiculite.....	(1)	(1)	(1)	(1)	(1)	(1)
Miscellaneous.....	(1)	(1)	(1)	(1)	(1)	(1)
Total value, eliminating duplications.....	64,070,497			70,737,000		73,031,000

* No census.

† Not valued as ore; value of recoverable metal content included under the metals.

‡ Includes minerals indicated by "†" above.

1 Value included under "Miscellaneous."

2 Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products.

PART II. METALS

GOLD AND SILVER

By C. E. NEEDHAM

SUMMARY OUTLINE

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GENERAL SUMMARY

Although it might have seemed that the gold industry in the United States had reached bottom in 1943, such was not the case, for mine production in 1944 continued to decline sharply and totaled less than a million ounces—27 percent under the 1943 figure—for the first year since 1847. The number of gold mines in operation decreased further, as did employment, and gold output became more and more a by-product of base-metal mining. The issuance of Government permits for the limited production of gold under Order L-208 had little effect in increasing the output, as labor and supplies were virtually unobtainable, and decreased base-metal production and a lower gold content of base-metal ores lowered further the yield from this source.

Reduced output of gold from the 1943 figure was general over the world, averaging an estimated 8 percent. Canadian production dropped 22 percent; South African, 4; Nicaraguan, 10; Australian, 16; Indian, 26; and Gold Coast, 8; Brazil, Colombia, Mexico, Peru, and Venezuela also showed decreases.

Silver output in the United States in 1944 likewise declined from that in 1943—17 percent. Production from base-metal ores was maintained at more than 80 percent of the 1943 rate, but dry and siliceous ore contributed little more than half the quantity from this source in 1943. Output in Canada was down 21 percent. Mexican production slumped appreciably—14 percent—but output from Peru rose 7 percent.

Salient statistics of gold and silver in the United States,¹ 1925-29 (average) and 1941-44

	Average (1925-29)	1941	1942	1943	1944
Mine production, ounces:					
Gold.....	2, 170, 798	4, 750, 865	3, 457, 110	1, 363, 815	998, 394
Silver.....	61, 511, 087	67, 258, 997	54, 090, 765	41, 460, 826	34, 473, 540
Number of mines producing gold and silver:					
Lode.....	2, 187	4, 542	2, 619	1, 394	1, 186
Placer.....	1, 243	3, 349	1, 753	362	367
Ore (dry and siliceous) produced, short tons:					
Gold ore.....	7, 014, 646	15, 117, 117	9, 487, 907	3, 766, 149	1, 964, 680
Gold-silver ore.....	597, 075	1, 447, 371	1, 163, 970	553, 566	364, 698
Silver ore.....	799, 061	1, 074, 543	996, 823	643, 271	290, 297
Percentage derived from—					
Dry and siliceous ores:					
Gold.....	57	54	50	38	30
Silver.....	21	41	37	26	17
Base metal ores:					
Gold.....	23	14	21	50	58
Silver.....	79	59	62	74	83
Placers:					
Gold.....	20	31	29	12	12
Silver.....	(²)	(²)	(²)	(²)	(²)
Net industrial consumption:					
Gold.....	\$27, 938, 073	\$37, 001, 620	\$47, 294, 810	\$86, 343, 353	\$110, 539, 973
Silver, ounces.....	28, 747, 779	72, 432, 318	101, 398, 695	118, 000, 000	120, 100, 000
Imports:					
Gold.....	\$201, 971, 673	\$982, 442, 027	\$315, 779, 716	\$101, 792, 745	\$113, 836, 359
Silver.....	\$64, 264, 486	\$47, 053, 413	\$41, 103, 149	\$27, 902, 960	\$23, 373, 037
Exports:					
Gold.....	\$251, 428, 995	\$64, 280	\$102, 126	\$32, 854, 590	\$959, 227, 923
Silver.....	\$87, 559, 828	\$5, 673, 361	\$1, 999, 490	\$30, 689, 397	\$126, 915, 344
Monetary stocks:					
Gold.....	\$4, 339, 000, 000	\$22, 737, 000, 000	\$22, 726, 000, 000	\$21, 938, 000, 000	\$20, 619, 000, 000
Silver, ounces.....	1, 417, 000, 000	3, 280, 000, 000	3, 334, 000, 000	3, 254, 000, 000	2, 999, 000, 000
Price, average, per ounce:					
Gold.....	\$20. 67+	\$35. 00	\$35. 00	\$35. 00	\$35. 00
Silver.....	\$0. 600+	\$0. 711+	\$0. 711+	\$0. 711+	\$0. 711+
World production, ounces:					
Gold.....	18, 988, 557	40, 291, 000	35, 514, 000	29, 429, 000	27, 070, 000
Silver.....	254, 377, 085	261, 566, 000	247, 744, 000	217, 041, 000	186, 200, 000

¹ Philippine Islands and Puerto Rico excluded.

² Less than 0.5 percent.

LEGISLATION AND REGULATIONS

Gold.—Following an increase in the amount of gold entering neutral countries from Germany, the Treasury Department in February issued a regulation declaring that thereafter the United States would not buy any gold located outside of the territorial limits of the United States from any country that had not broken relations with the Axis or from any country that after the date of this regulation acquired gold from any country that had not broken relations with the Axis. Provision was made, however, for recognition of the title if the United States were fully satisfied that the gold in question had not been acquired directly or indirectly from Axis Powers. The United Kingdom and Russia made similar declarations governing looted gold.

On September 1 a bill was introduced into both branches of Congress to "permit the sale in foreign markets of newly mined gold or silver produced within the United States, its Territories and possessions, including Alaska, and which may be surplus to the war effort." The bill was designed primarily to permit domestic producers of gold to

the advantage of the high price for the metal in the Indian market, but it was quickly pointed out that because of existing exchange conditions sales of United States gold, over and above the rupee needs of our military forces, would produce only rupee credits which could not now be converted. Hence the bill would have worked to the detriment rather than to the benefit of American gold producers.

In October the War Production Board granted authority to gold mines to purchase equipment and materials for rehabilitating their properties so that operations could be resumed as soon as Order L-208 was canceled, but following military reverses on the western front late in the year and the consequent resumption of full wartime production the board announced that action on gold mines would be delayed.

Silver.—Wartime restrictions on the silver industry continued throughout 1944, with certain modifications from time to time. On June 1 the Office of Price Administration issued Revised Maximum Price Regulation 198 establishing consolidated and simplified controls of silver prices and quantity price ceilings on sales of commercial bars by refiners and others. On December 20 the President signed the 1-year extension of the Green Act relating to the use of Treasury silver for domestic consumption.

MONETARY AND ECONOMIC CONSIDERATIONS

The years between World Wars I and II witnessed many kinds of economic hostilities and monetary upheavals between numerous nations. Realizing the crying need for commercial policies designed to facilitate orderly revival and expansion of international trade and to establish proper trading practices in the postwar period, representatives of 44 United and Associated Nations assembled at Bretton Woods N. H., in July 1944 to formulate plans for setting up a permanent agency to deal with the many problems bound to arise in this respect. The texts of the proposals are voluminous, the language is involved and technical, certain statements are clouded and difficult of interpretation, and many controversial details are avoided; yet the proposals represent the first tentative steps toward establishing trade and investments on a sound basis among nations after the war and avoiding some of the treacherous economic and monetary pitfalls that followed World War I. The agreements, in draft form, were submitted to the various governments, none of which was bound to accept them.

Two important provisions of the agreements are emphasized, one for the establishment of an International Monetary Fund and the other for the establishment of an International Bank for Reconstruction and Development.

The aims of the Fund are to promote exchange and currency stability as a means of restoring world trade, to establish a procedure for changing exchange rates when necessary, to eliminate such destructive practices as indiscriminate exchange restrictions, multiple currency practices, and bilateral clearing agreements, to assure member countries that the proceeds of sales to any one member can be used for the purchase of goods from any other member, and to re-establish international currencies on a gold basis, seemingly as a form of modified gold standard.

The Fund is intended to operate on a short-loan basis, to provide a revolving fund to meet temporary shortages in the balance of payments of the member countries. It was pointed out that such a fund cannot be used in the hope of curing the basic economic ills of a nation but at best can only tide over the country for the time being; and that in the final analysis currency stability is not a matter of monetary mechanisms alone but depends primarily on a stable government and sound internal economic policies; hence, it begins at home.

Holdings for the Fund would be built through assigned member quotas in gold and national currencies and would total \$8,800,000,000 for the countries represented at the conference. The gold part of the subscription would be a minimum of 25 percent of the country's quota or 10 percent of its net official holdings of gold and United States dollars, whichever is smaller. The quota of the United States was placed at \$2,750,000,000, of which about \$687,500,000 would be required in gold.

Among the more important objections that have been voiced against the plan may be mentioned the following: The plan seeks to substitute a managed paper currency for the tried and tested gold and silver standards; the proposals seem grandiose and overambitious; too much emphasis is placed on the financial and credit machinery of stabilization and too little on the underlying essentials of sound internal economies and liberal trade policies; the plan is weak in its system of quotas and rights to start borrowing without question of credit worthiness from a large general fund; the proposals should contain more definite commitments on the maintenance of exchange stability and abandonment of exchange restrictions; creditor countries, particularly the United States, are concerned about having adequate safeguards against abuse of the Fund's resources; the Fund's holdings are larger than is necessary and under proper organization and management could be reduced to half this amount and still accomplish the same purposes.

Early in 1945 a movement was made to have the plan approved at once by the Congress, but the opposition countered with the proposal that it would be better to hold another conference in an effort to clear up some of the objectionable features mentioned above.

The proposed International Bank for Reconstruction and Development would operate on a basis of long-term productive foreign loans to member countries. Its broad objectives would be to assist reconstruction and development of territories of members; to promote foreign investment by means of guarantees or participations in loans; to promote the long-range balanced growth of international trade and the maintenance of equilibrium in balances of payments; to arrange the loans made or guaranteed by it in relation to international loans; and to conduct its operations with due regard to the effect of international investment on business conditions in the territories of members.

To promote this international flow of long-term capital the International Bank would be provided with \$10,000,000,000, but initial payments of each member country would be limited to 20 percent of its quota. The balance of 80 percent would be called only as needed.

The Bank's organization was considered by many to be simpler and more understandable than that for the Fund and appears to have

been received more favorably in many quarters. It was stated to be as ambitious in lending power than the Fund and also in provisions to safeguard individual credits. However, the question was raised as to the \$10,000,000,000 capital might be larger than necessary in view of the large gold and dollar resources now held by many countries.

POSTWAR OUTLOOK

The postwar outlook for gold continues dark and appears to have brightened but little during the past year. (See *Minerals Yearbook*, 1945, pp. 94-95.) The situation has worsened to the extent that the War Production Board Limitation Order L-208 was not revoked until July 1, 1945; consequently, many closed mines continued to operate in 1944. Also, wholesale commodity prices (1926=100) rose from 103 in 1943 to 104 in 1944, thereby reducing further the purchasing power of the gold ounce, and relief from numerous other increases in the cost of mining is not in prospect. Even the hope was held for an increase in the price of gold, upon which the future of the industry depends so greatly, received scant support from the Congress and Government monetary experts. On the other hand, officials in some countries, Union of South Africa, for example, have stated that a free market for gold is a requirement in any postwar arrangement, under which it is believed that a much greater price for the metal would be obtained. The extent and influence of such a movement cannot be predicted at this time.

Concerning the outlook for the domestic industry, Merrill¹ writes as follows:

If the postwar period price level is stabilized well above the average during the period 1935-40 and if gold remains at \$35 per ounce, the outlook for the domestic gold miner will be gloomy indeed. Not only would the gold industry be in an economic situation similar to that in the twenties, but it would enter the period with its mines largely idle and in disrepair; many operating companies would not have enough funds to finance resumption of production. A substantial stabilization of the industry seems to lie largely with the gold price higher than \$35 an ounce, but this possibility cannot now be appraised with assurance.

Regarding the relation between the price of gold and the high cost of producing it, Needham² makes the following comments:

Virtually every factor in the cost of mining gold has increased. Advances in the cost of supplies are indicated by the rise in the wholesale commodity index (1906=100) from 66 in 1939 to 103 in 1943. The cost of labor likewise has increased. * * * Taxes and insurance costs are considerably higher than in former days and are likely to continue at a high level in postwar years. * * * Mechanization doubtless will expand in the future, but the present outlook is that only moderate savings in unit labor costs can be anticipated. Barring fortuitous discoveries of high-grade deposits the average grade of gold ore mined will continue the downward trend evident in the past. From the long range few major reductions in other cost items such as taxes and supplies are not in sight. It may be said therefore that the cost of producing gold in the United States, which already has undergone a large increase since the early 1930's, seems likely to increase for some time to come if a substantial volume of production is maintained.

Although the postwar outlook for silver is reasonably good, for a number of reasons the industry is not likely to return to the prosperous

¹Merrill, Charles White, *War and Gold*: Eng. and Min. Jour., vol. 146, May 1945, p. 89.
²Needham, C. E., *The Gold Industry of the United States*: Min. and Ind. Mag. of South Africa, vol. 8, No. 2, February 1945, pp. 109, 111; *South African Min. and Eng. Jour.*, vol. 56, Mar. 10, 1945, pp. 35, 37.

period of 1940-41 unless the price of the metal is increased or the volume of base-metal output is maintained at a very high rate.

Delegates to the Bretton Woods Conference evinced little interest in extending the monetary use of silver, and until public opinion undergoes a changed attitude toward the silver question it seems unlikely that any appreciable increase, if indeed any at all, in the price of the metal will be made in the immediate postwar period.

It is believed that in the postwar epoch Government policy will favor reduced tariffs and that some base metals will be included in the new schedules. This reduction, coupled with declining reserves and the general lower tenor of base-metal ores, is expected to bring about a reduced output of base metals and of the silver derived from them. However, the base-metal industry will continue to supply a large and important part of domestic silver output.

Many mines that operated largely or entirely on dry and siliceous silver ore have closed during the war because of high mining costs, a fixed price for the metal, and inability to procure labor and supplies. Many of these will not reopen after the war; those that do reopen will face continued high costs of production, deteriorated mines, and insufficient developed ore. Consequently, it is quite unlikely that output from this source will return to its prewar level unless the price of silver is increased.

The industrial demands for silver after the war should continue strong compared with the prewar period. It has been found that silver is particularly well adapted to many industrial uses, many of which will be retained in the future. However, the extent to which the metal is used in industry depends much on its being low enough in price that substitutes do not crowd it out.

In conclusion it may be said that the future of the silver industry rests largely on the two factors of Government price and the price of copper, lead, and zinc.

DOMESTIC REFINERY PRODUCTION

The figures in the following table were obtained through cooperation between the United States Bureau of the Mint and the Bureau of Mines and were agreed upon after conference and adjustment between the two Bureaus.

The State totals are based upon bullion deposits in the United States mints and assay offices and upon returns to the Bureau of the Mint from smelting and refining companies. The state distribution is adjusted further by the Bureau of Mines from its geographical records of sources and production, both historical and current, from the producing mines and is tabulated for the mine reports discussed later. The data for the total production and in part for the distribution are obtained from records of (1) the unrefined domestic gold and silver deposited in the United States mints and assay offices; (2) the domestic gold and silver in fine bars reported by private refineries, supplemented by data of content of unrefined mattes, blister copper, copper anodes, and lead bullion; and (3) the unrefined domestic gold and silver contained in ore and matte exported for reduction. The last item is small.

Gold and silver produced in the United States, 1940-44, and approximate distribution of source, by States and Territories, in 1944

[Refinery figures supplied by U. S. Bureau of the Mint]

State or Territory	Gold ¹		Silver ¹	
	Fine ounces	Value	Fine ounces	Value
Alaska	6,003,105	\$210,108,700	69,585,734	\$49,483,189
Arizona	5,976,419	209,174,600	72,336,029	51,438,954
California	3,741,806	130,963,210	56,090,855	39,886,830
Colorado	1,394,522	48,808,270	40,900,121	29,084,530
Idaho	50,848	1,779,680	15,240	10,837
Montana	127,619	4,466,665	4,674,097	3,323,802
Nevada	115,555	4,044,425	791,519	562,858
Utah	111,484	3,901,940	2,136,140	1,519,033
Wyoming	4	140		
Nebraska	22,326	781,410	10,645,179	7,569,905
North Dakota			3,002	2,135
South Dakota			53,605	38,119
Wisconsin			104,361	74,212
Minnesota	49,127	1,719,445	6,689,273	4,742,594
Michigan	115,561	4,044,635	1,408,259	1,001,429
New Mexico	11,535	403,725	545,081	387,613
New York			29,029	27,754
North Carolina	21	735	1,461	1,039
Georgia	1,290	45,150	18,599	13,226
Pennsylvania	2,117	74,095	13,549	9,635
South Carolina	10,875	380,625	5,312	3,778
Tennessee	222	7,770	45,907	32,645
Alabama	43	1,505	21,471	15,268
Arkansas	353,557	12,374,250	8,104,520	5,763,214
Florida	101	3,535	18,914	13,450
Illinois	95	3,325	19,297	13,722
Washington	49,846	1,744,610	317,231	225,587
Oregon	19	665	3	2
	1,022,238	35,778,330	35,651,049	25,351,857

¹Gold valued at \$35 a fine ounce.

²Silver valued at \$0.711+ a fine ounce.

Gold and silver produced in the United States, 1792-1944

From Report of the Director of the Mint. The estimate for 1792-1873 is by R. W. Raymond, commissioner of mining statistics, and since then by the Director of the Mint]

Period	Gold		Silver	
	Fine ounces	Value ¹	Fine ounces	Value ¹
1792-96	1,187,170	\$24,537,000	309,500	\$404,500
1897-1900	58,279,778	1,204,750,000	118,568,200	157,749,900
1901-1904	214,110,795	5,066,675,100	3,743,073,719	2,809,647,066
	273,583,743	6,295,962,100	3,861,951,419	2,967,801,466

¹Gold valued in 1934 and thereafter at \$35 per fine ounce; prior thereto at \$20.67+ per fine ounce. Dollar figures rounded.

²Silver valued in 1934 and thereafter at Government's average buying price for domestic product: In 1934 at \$0.64+ per fine ounce, in 1935 at \$0.71875, in 1936 at \$0.7745, in 1937 at \$0.7735, in 1939 at \$0.678787+, in 1940-44 at \$0.7111+.

PRICES OF GOLD AND SILVER

Since January 1934 the price of gold at the United States Mint has been \$35 per fine troy ounce; the price of domestic silver mined after July 1, 1939, was fixed at \$0.711+ per ounce on July 6, 1939. A complete account of regulations pertaining to gold and silver in 1933-34 is given in the chapter on Gold and Silver in Minerals Yearbook, 1934 (pp. 25-46).

According to the Director of the Mint, the following prices for silver prevailed in London and New York throughout 1944: London price per ounce, 0.925 fine, 23.5 d.; exchange, New York on London, \$4.0350; United States equivalent, per fine ounce, of London price at current rate of exchange, \$0.42713; New York price of fine bar silver, \$0.45062.

UNITED STATES AND WORLD MONETARY STOCKS

Gold holdings of the United States dropped \$1,319,000,000 (1 percent) from \$21,938,000,000 on January 1, 1944, to \$20,619,000,000 on January 1, 1945, according to the Federal Reserve Bulletin. Total world reserves are not positively known, inasmuch as data are not available from a number of countries, including the United Kingdom, Germany, Italy, Japan, Australia, and Russia. However, the Federal Reserve System estimates the total at about \$35,000,000,000, of which nearly 60 percent is held by the United States.

Increases in foreign gold reserves have been rapid since the United States entered the war late in 1941, largely because our gold is being lost to the countries that have export trade balances with us. In this time foreign reserves have increased more than \$5,000,000,000, and United States reserves have declined \$2,000,000,000. Sharing prominently in this increase are Switzerland, Sweden, Turkey, Iran, Portugal, Spain, South Africa, and the Latin American countries.

As a result, many foreign countries will enter the postwar period well-supplied with gold, and these reserves promise to be an element of strength in rehabilitating war-torn Europe.

United States Treasury silver holdings declined considerably more rapidly in 1944 than in 1943, the loss reaching nearly 255,000,000 ounces, so that at the close of the year silver reserves approximated 2,999,000,000 ounces.

The Twenty-ninth Annual Review of the Silver Market, 1944, by Handy and Harman, contains the following comments on Treasury purchases, sales, and domestic coinage:

For the second successive year since the inauguration of the silver purchase program in 1934, United States Government silver holdings showed a decrease, bringing the amount on hand at November 30, 1944, down to just below 3 billion ounces. The reduction in 1943 amounted to 85,300,000 ounces, but for the first 11 months of 1944 it was three times as large; namely, 254,700,000 ounces. This amount was a net figure consisting of 255,000,000 ounces released and less than 300,000 ounces acquired. The acquisitions represented 119,528 ounces of newly mined domestic silver and 151,669 ounces of miscellaneous deposits received at the mints and assay offices. No foreign silver was purchased. Treasury disposals during the 11-month period were comprised as follows: The minting of "silver" nickels accounted for 8,489,000 ounces; sales under the Green Act absorbed 43,672,000 ounces; lend-lease procedure made 202,807,000 ounces available to foreign governments, a total of 255,000,000 ounces. The governments receiving lend-leased silver were Australia, Ethiopia, Great Britain, India, the Netherlands, and Saudi Arabia.

According to the Treasury's Daily Statement dated December 30, 1944, there were 1,175,700 ounces of silver pledged as backing for silver certificates and 868,700,000 ounces which remained unpledged. Of this, 2,044,400,000 ounces of Government-owned bullion, the Defense Plant Corporation, etc., held 880,000,000 ounces, an amount which was 51,000,000 ounces more than at the end of 1943, but 22,000,000 ounces less than the peak recorded early in 1944.

Domestic coinage in the United States declined below the record figure established in 1943. As compared with that year's consumption of 98,485,000 ounces,

In 11 months of 1944 absorbed only 64,496,000 ounces according to official figures, a decrease of nearly 35 percent. As previously mentioned, 8,489,000 ounces were minted into "silver" nickles and the balance of 56,007,000 ounces into half-dollars, quarters and dimes. Foreign coinage produced by United States Mints during the first 11 months consumed 79,102,000 ounces of silver, of which 12,048,000 ounces were furnished by other governments. The remaining 67,054,000 ounces were made available under lend-lease and represented part of the 11,807,000 ounces derived from that source. The Governments for which the coins were minted in 1944 were Australia, Dominican Republic, El Salvador, Ethiopia, the Netherlands, Philippine Islands and Saudi Arabia.

CONSUMPTION AND USES

Silver.—War and other essential uses consumed an estimated 70,000 to 85,000,000 ounces of silver in 1944. Solders and brazing alloys were used extensively in almost all important military equipment, occupied first place. Following closely for war purposes were photographic applications, electrical appliances, engine bearings, and military insignia. Appreciable quantities continued to be absorbed in making eating utensils for the armed forces, desalination equipment, dental and medical supplies. Consumption declined in civilian uses and also in low-melting solders.

For allocation the War Production Board divided silver into three classes: Treasury, domestic, and foreign.

Treasury silver was eligible for engine bearings, official military insignia, solders and brazing alloys, identification neck chains, and desalination kits. Domestic silver was permitted in silverware, jewelry, watch cases, church articles, pens and pencils, mirrors, and other items classed as nonessential. Foreign silver was limited to photographic uses, electrical appliances, medical and dental supplies, and other items and processes bearing preference ratings.

Although imports declined from 1943, supplies of foreign silver in 1944 were more than sufficient for the uses specified by the War Production Board, and a considerable surplus accumulated. On the other hand domestic silver was in short supply, and much criticism was directed at the Board for alleged refusal to follow the spirit and the letter of the Green Act in making Treasury silver available for civilian needs. Consequently, by fall it became necessary for suppliers to ration regular users of silver far below the 50-percent quota established by the Board.

Late in the year Secretary Morgenthau announced that since Pearl Harbor silver transactions under Treasury policy were as follows: Under lease arrangements for nonconsumptive uses in war plants, 903,000,000 ounces; supplied to various governments under lend-lease for coinage and other war uses, 243,700,000 ounces; sold from "silver primary" stock to industrial users, 5,000,000 ounces; sold under the Green Act, 41,000,000 ounces; for coinage in "silver nickels," 33,600,000 ounces.

Earlier, the Secretary also announced that through a special lend-lease agreement India would be supplied with 100,000,000 ounces of silver to be used for additional coinage and expanded war production, and to help stabilize prices in the fight against inflation. After the war the metal will be returned ounce for ounce.

*Net industrial consumption of gold and silver in the United States, 1940-44*¹

Year	Gold (dollars)			Silver (fine ounces)		
	Returned from industrial use	Issued for industrial use	Net industrial consumption	Returned from industrial use	Issued for industrial use	Net industrial consumption
1940.....	27,872,355	41,178,387	13,306,032	22,563,729	67,062,632	44,498,903
1941.....	30,975,490	67,977,110	37,001,620	20,361,256	92,793,574	72,432,318
1942.....	28,447,685	75,742,495	47,294,810	30,020,529	131,419,224	101,398,695
1943.....	10,521,000	96,864,353	86,343,353	44,112,863	162,112,863	118,000,000
1944.....	25,678,940	136,218,913	110,539,973	56,189,409	176,289,409	120,100,000

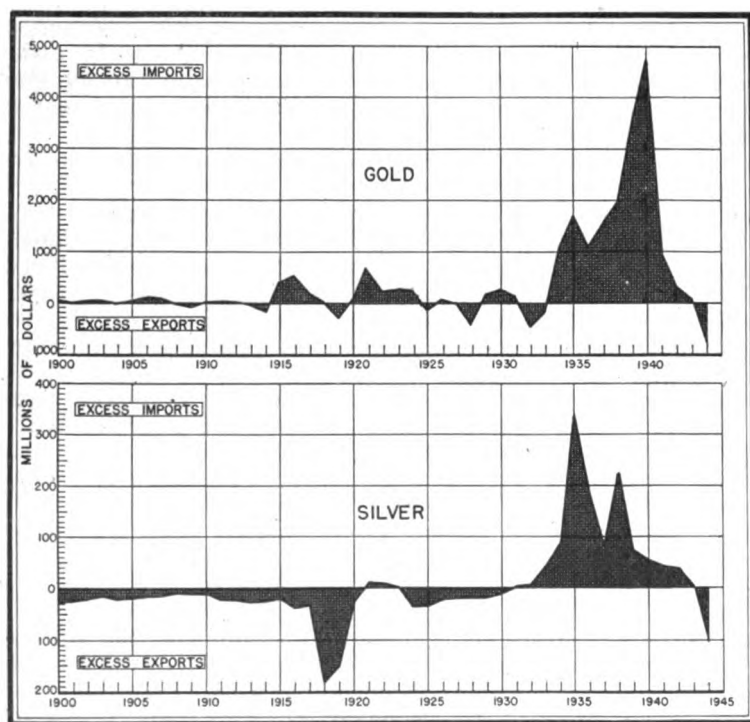
¹ U. S. Bureau of the Mint.**IMPORTS AND EXPORTS**²**FIGURE 1.—Gold and silver imports and exports, with net movements, 1900-1944.**² Figures compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Table of gold and silver imported and exported from the United States, 1943-44, by classes

	Imports	Exports	Excess of imports over exports
1943			
Gold:			
Contained in ore and base bullion.....	\$41,476,425	\$2,161	\$41,474,264
Bullion refined.....	60,257,619	24,110,100	36,147,419
United States coin.....	58,801	8,742,329	18,683,528
Foreign coin.....			
	101,792,745	32,854,590	68,938,155
Silver:			
Contained in ore and base bullion.....	17,667,905	188,381	17,479,524
Bullion refined.....	9,933,867	15,451,062	15,517,195
United States coin.....	290,741	1,328,650	11,037,909
Foreign coin.....	10,447	13,721,304	13,710,857
	27,902,960	30,689,397	12,786,437
1944			
Gold:			
Contained in ore and base bullion.....	37,186,832		37,186,832
Bullion refined.....	63,347,641	959,054,499	1895,706,858
United States coin.....	9,703		9,703
Foreign coin.....	13,292,183	173,424	13,118,759
	113,836,359	959,227,923	1845,391,564
Silver:			
Contained in ore and base bullion.....	16,567,093		16,567,093
Bullion refined.....	6,093,323	97,218,077	191,124,754
United States coin.....	704,080	4,589,100	13,885,020
Foreign coin.....	8,541	25,108,167	125,099,626
	23,373,037	126,915,344	1103,542,307

¹ Excess of exports.

DOMESTIC SUPPLY

Base-metal ores in 1944 continued to increase in relative importance as sources of gold and silver, and dry and siliceous ores declined compared with 1943, but placers as a source of gold recovered slightly from the low level of 1943.

Mine production of gold in the United States, 1940-44, by percent from sources, and in total fine ounces¹

Year	Percent from—						Total fine ounces
	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Zinc-lead, zinc-copper, lead-copper, and zinc-lead-copper ores	
1940.....	31.0	55.6	11.0	0.4	(7)	2.0	4,869,949
1941.....	31.2	54.3	11.8	.5	(7)	2.0	4,750,865
1942.....	29.2	50.0	17.0	.7	(7)	2.9	3,457,110
1943.....	11.6	38.3	39.5	1.1	0.3	9.2	1,363,815
1944.....	12.4	29.8	45.4	.9	.8	10.7	998,394

¹ Philippine Islands and Puerto Rico excluded.

² Less than 0.1 percent.

Mine production of silver in the United States, 1940-44, by percent from sources, and in total fine ounces¹

Year	Percent from—						Total fine ounces
	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Zinc-lead, zinc-copper, lead-copper, and zinc-lead-copper ores	
1940.....	0.3	41.3	29.3	4.5	(²)	24.6	70,549,362
1941.....	.3	41.2	27.9	5.6	0.3	24.7	67,258,997
1942.....	.3	37.3	27.8	5.5	1.2	28.0	54,090,765
1943.....	(²)	26.1	33.7	8.1	1.2	31.0	41,460,826
1944.....	(²)	17.1	34.4	12.0	2.2	34.3	34,473,540

¹ Philippine Islands and Puerto Rico excluded.

² Less than 0.1 percent.

MINE REPORT

METHOD OF COLLECTING STATISTICS

The second table in this report presents the official refinery figures for production of gold and silver in the United States from 1940 to 1944, as agreed upon by the Bureau of the Mint and the Bureau of Mines. These figures record the output of gold and silver bullion from domestic ore in marketable form as metals, either refined or unrefined.

To trace the gold and silver produced back to its source by States, counties, and mining districts, the Bureau of Mines systematically investigates the "mine production" of ores containing gold and silver and the output of the placer mines, the total being classified by methods of production and by kinds of ore, as well as by mining districts. The resulting figures form the basis of the mine reports.

Of the two systems for ascertaining the production of gold and silver, one is a measure of the metallurgic industry and the other of the mining industry; one reports the metal actually recovered in marketable form and the other the mine output and its recoverable content. The two methods will not produce identical results, but data for a period of years long enough to compensate for overlap or lag should agree within allowable limits of error.

Compared with the mine reports, the mint reports for the 40 years show a total excess of gold of 338,161 ounces (a difference of 0.24 percent) and a total excess of silver of 13,439,210 ounces (a difference of 0.58 percent).

Gold and silver produced in the United States, 1905-44, in fine ounces, according to mint and mine returns, in terms of recovered metals

Year	Mint		Mine	
	Gold	Silver	Gold	Silver
1905-39.....	124,925,716	2,025,813,631	124,867,875	2,016,347,731
1940.....	6,003,105	69,585,734	5,984,163	71,824,746
1941.....	5,976,419	72,336,029	5,881,798	68,483,333
1942.....	3,741,806	56,090,855	3,615,836	54,321,962
1943.....	1,394,522	40,900,121	1,377,579	41,486,897
1944.....	1,022,238	35,651,049	998,394	34,473,540
	143,063,806	2,300,377,419	142,725,645	2,286,938,209

UNITS OF MEASUREMENT

All tonnage figures are short tons of 2,000 pounds "dry weight"; that is, they do not include moisture. The weight unit for gold and silver is the troy ounce (480 grains). The totals are calculated upon the basis of recovered and recoverable fine gold and silver shown by assays to be contained in ore, bullion, and other material produced. Prices of gold and silver are discussed in a preceding section of this report.

NUMBER OF MINES

The following table indicates the number of mines that produced gold and silver in 1943 and 1944. The placers are those in which gold and silver in natural alloy and, in a few placers, platinum are recovered from gravel and sand, whether by hand washing, sluicing, hydraulicking, drifting (in frozen ground or ancient buried river channels), or dredging. The lode mines are those yielding gold and silver from ore as distinguished from gravel, mainly from underground workings, and include those that yield ore mined chiefly for copper, lead, or zinc but that contribute the precious metals as byproducts. As far as possible the unit is not the operator but the mining claim or group of claims.

Number of mines in the United States producing gold or silver, 1943-44, by States

State	Lode		Placer		Total	
	1943	1944	1943	1944	1943	1944
Alaska	8	9	114	198	122	207
Arizona	260	221	19	17	279	238
California	139	109	82	66	221	175
Colorado	236	193	17	13	253	206
Idaho			3	2	3	2
Montana	127	112	30	20	157	132
Nebraska	2	2			2	2
Nevada	2	2			2	2
New Mexico	3	3			3	3
North Carolina	223	187	45	24	268	211
North Dakota	168	145	17	11	185	156
Ohio	69	53	16	3	75	56
Oklahoma	1	1			1	1
South Carolina	3	3			3	3
South Dakota	16	13	16	10	32	23
Tennessee	1	1			1	1
Texas	1				1	
Utah	3	2			3	2
Virginia	1	1			1	1
Washington	8	3			8	3
West Virginia	107	97	1		108	97
Wyoming	1	1			1	1
	24	25	2	3	26	28
		1				1
	1,394	1,186	362	367	1,756	1,553

MINE PRODUCTION

The following table gives the mine production of gold and silver in 1943 and 1944, by States, in terms of recovered metals, as calculated by the Bureau of Mines from reports from the producing mines.

Mine production of gold and silver in the United States, 1943-44, by regions and States, in terms of recovered metals¹

Region and State	Gold			Silver				
	Fine ounces		Increase or decrease (percent)	Value (at \$35 per ounce)		Increase or decrease (percent)		
	1943	1944		1943	1944			
Western States and Alaska:								
Alaska.....	99,583	49,296	-55	\$3,485,405	1,725,360	-69	\$30,427	9,592
Arizona.....	171,810	112,162	-35	6,013,350	3,925,670	-23	4,063,210	3,124,650
California.....	148,328	117,373	-21	5,191,480	4,108,055	-20	4,433,120	3,553,910
Colorado.....	137,558	111,455	-19	4,814,530	3,900,925	-18	1,690,501	1,599,168
Idaho.....	30,808	25,008	-19	1,078,280	875,280	-18	8,320,128	7,062,481
Montana.....	59,886	50,021	-16	2,085,510	1,750,735	-16	6,090,152	5,044,054
Nevada.....	144,442	119,056	-18	5,055,470	4,166,960	-22	1,352,199	895,741
New Mexico.....	5,563	6,918	+24	194,705	242,130	+25	329,650	380,640
Oregon.....	1,097	1,369	+25	38,395	47,915	+25	7,483	14,395
South Dakota.....	106,444	11,621	-89	3,725,540	406,735	-89	25,519	3,808
Texas.....	4	4	-100	140	10,284	-98	7,313	3,808
Utah.....	390,470	344,223	-12	13,665,450	12,047,805	-12	6,740,864	5,309,590
Washington.....	65,244	47,277	-28	2,283,540	1,654,695	-28	263,424	228,600
Wyoming.....		20			700			
	1,360,937	995,799	-27	47,632,795	34,852,965	-27	29,276,999	24,320,452
Eastern States:								
Georgia.....	12	5	-58	420	175	-58	27,025	17,947
New York.....		21	-84	4,585	735	-80	5,068	6,030
North Carolina.....	131		-5	77,630	74,025	+3	9,312	9,632
Pennsylvania.....	2,218	2,115	-5	5,145	13,545		96	
South Carolina.....	147		-100	5,145	45,907	-12	37,019	32,645
Tennessee.....	303	222	-27	10,605	52,058	+593	1,935	13,413
Vermont.....	17	100	+488	595	3,500	+27	10,629	13,506
Virginia.....	50	132	+164	1,750	4,620			
	2,878	2,595	-10	100,730	90,825	-3	91,114	88,182
Central States:								
Illinois.....						+13	1,531	1,733
Michigan.....						+12	34,474	38,555
Missouri.....						-17	79,136	65,595
						-8	115,141	105,883
						-17	20,483,254	24,514,517
	1,363,815	998,394	-27	47,733,525	34,943,790	-27	29,483,254	24,514,517

Gold and silver produced in the Western States of the United States, 1848-1944, and in Alaska, 1880-1944, in terms of recovered metals

Original research, 1848-1903, by Chas. W. Henderson; 1904-44, Economics and Statistics Branch]

State	Period	Gold		Silver	
		Fine ounces	Value	Fine ounces	Value
Alaska	1880-1944	25,788,530	\$615,613,152	19,738,522	\$14,040,723
Arizona	1880-1944	10,711,912	262,412,075	285,860,433	212,093,250
California	1848-1944	101,370,457	2,250,279,647	106,870,639	85,354,857
Colorado	1858-1944	38,814,395	852,380,789	725,959,747	564,178,595
Idaho	1863-1944	7,772,994	175,439,193	505,551,641	347,998,840
Montana	1862-1944	16,937,017	377,248,807	739,934,613	540,205,853
Nevada	1859-1944	25,334,056	565,253,636	687,309,681	538,974,117
New Mexico	1848-1944	2,173,222	49,395,953	66,951,604	52,341,337
Utah	1852-1944	5,669,487	126,395,088	5,207,924	4,781,399
West Dakota	1876-1944	20,678,106	505,330,919	9,574,544	4,510,932
Wyoming	1885-1944	8,281	223,780	33,202,176	25,365,836
Alaska	1880-1944	10,184,466	256,651,350	708,947,621	516,415,620
Alaska	1880-1944	2,060,642	51,192,793	12,283,976	8,695,697
Alaska	1887-1944	77,934	1,836,018	74,635	51,754
Total, Western States and Alaska	1848-1944	267,603,499	6,069,684,210	3,806,767,656	2,915,302,360

ORE PRODUCTION, CLASSIFICATION, METAL YIELD, AND METHODS OF RECOVERY

The best index of lode mining is the quantity and metallic content of ore mined rather than the number of mines or operators. The following tables give details of classes of ore, metal yield in fine ounces of gold and silver to the ton, and gold and silver output by classes of ore and by methods of recovery, embracing all ores that yielded gold and silver in the United States (excluding the Philippine Islands and Puerto Rico) in 1944. The individual State chapters from which these tables were compiled contain additional tables and text on the subject and may be found elsewhere in this volume.

The classification originally adopted in 1905 on the basis of smelter terminology, smelter settlement contracts, and smelter recovery has been used continuously in succeeding years, except for modifications necessitated by the improvement in recovery of metals and the lowering of grade of complex ores treated, accomplished by improved mill concentration processes. A "dry" ore is one that carries so little lead or copper that by itself in quantity it would not satisfy the requirements for the smelter charge in lead smelting or copper smelting, respectively. The copper ores include those smelting ores that contain 2.5 percent dry assay or more of copper (or less than this percentage if no other metal is present), or those ores concentrated chiefly for their copper content. The lead ores are those that contain 5 percent dry assay (minimum lead smelting charge requires 7.5 to 8.5 percent wet assay) or more of lead, irrespective of precious-metal content; an ore that carries any grade of lead exclusively is called a lead ore. Zinc smelting ores (chiefly oxides) range from 16 to 45 percent zinc; zinc concentrating ores include any grade of zinc ore that makes marketable zinc concentrate, irrespective of precious-metal content. The mixed ores are combinations of those enumerated. The smelter classification applies to concentrates.

Siliceous (silica ⁴ in excess of iron) gold, gold-silver, and silver ores ¹ have where mineralization approaches a matte, ores in their natural state generally contain more silica than iron and usually are highly siliceous.

containing too little copper, lead, or zinc to be classified as copper, lead, zinc, or mixed ores are called "dry" ores regardless of the ratio of concentration, except low-grade ore milled chiefly for its copper content and having very little or no precious-metal content (chiefly

Ore produced in the United States and average recovery in fine ounces of gold and silver per ton in 1944¹

State	Gold ore			Gold-silver ore			Silver ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States:									
Arizona.....	56,008	0.147	0.28	61,520	0.020	0.94	11,558	0.028	10.27
California.....	131,258	.243	.44	2,581	.087	2.28	1,758	.052	6.62
Colorado.....	557,810	.159	.83	20,930	.168	2.62	62,124	.009	10.79
Idaho.....	256,640	.052	.53	80	.250	11.90	108,527	.001	20.43
Montana.....	97,928	.219	.25	68,154	.051	4.11	65,317	.012	4.80
Nevada.....	374,071	.134	.08	48,037	.062	2.83	3,551	.061	2.15
New Mexico.....	182	2.170	1.56	1,866	.574	32.97	217	.....	4.72
Oregon.....	2,628	.352	.94	1,561	.096	10.73	28	.....	34.86
South Dakota.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Texas.....	.....	.....	.....	.....	.....	.....	361	.....	11.32
Utah.....	47,410	.216	1.90	157,271	.049	2.79	36,656	.038	1.30
Washington.....	59,165	.345	2.17	2,698	.074	1.51	200	.010	9.13
Wyoming.....	6	3.333	.50	.....	.....	.....	.....	.....	.....
Alaska.....	1,583,106	.163	.60	364,698	.056	2.90	290,297	.012	13.41
Eastern States.....	381,574	.041	.02	.....	.....	.....	.....	.....	.....
	1,964,680	.139	.49	364,698	.056	2.90	290,297	.012	13.41
State	Copper ore			Lead ore			Lead-copper ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States:									
Arizona.....	35,288,865	0.003	0.09	27,101	0.052	3.02	.....	.....	.....
California.....	556,378	.006	.04	39,061	.050	7.67	.....	.....	.....
Colorado.....	7,880	.012	3.46	11,123	.118	8.17	.....	.....	.....
Idaho.....	3,232	.073	1.19	252,944	.001	12.57	39	.....	213.00
Montana.....	5,340,862	.002	1.03	16,857	.055	3.93	.....	.....	.....
Nevada.....	6,131,967	.009	.04	13,993	.037	11.69	.....	.....	.....
New Mexico.....	7,207,554	(?)	.02	4,277	.146	4.74	.....	.....	.....
Oregon.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
South Dakota.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Texas.....	3,799	.....	.33	.....	.....	.....	.....	.....	.....
Utah.....	29,930,659	.009	.09	15,926	.136	8.93	.....	.....	.....
Washington.....	36	.111	8.94	477	.....	1.19	.....	.....	.....
Wyoming.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Alaska.....	84,521,232	.005	.14	381,779	.024	10.59	39	.....	213.00
Eastern States.....	1,132,178	(?)	.06	.....	.....	.....	.....	.....	.....
	85,653,410	.005	.14	381,779	.024	10.59	39	.....	213.00

See footnotes at end of table.

Produced in the United States and average recovery in fine ounces of gold and silver per ton in 1944¹—Continued

State	Zinc ore		Zinc-lead, zinc-copper, and zinc-lead-copper ores ¹			Total ore			
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States:									
Arizona	2,468	0.006	3.29	453,121	0.019	2.22	35,900,641	0.003	0.12
California	69,204	.058	2.81	125,693	.006	1.44	925,953	.046	.84
Colorado	5,939	.028	.60	884,616	.019	1.06	1,550,422	.020	1.17
Idaho	128,982	.001	.58	2,520,594	.004	1.71	3,271,038	.008	3.04
Montana	201,470	(?)	.40	258,874	.016	3.14	6,049,462	.007	1.17
Nevada	225,019	.014	1.68	16,867	.011	7.46	6,863,505	.016	.18
New Mexico	6,332	(?)	.20	723,418	.003	.46	7,943,846	.001	.06
Utah							4,217	.255	4.79
South Dakota				2,839	.044	.98	2,839	.044	.98
Texas							4,160		1.29
Washington	95,968	(?)	.13	656,315	.056	5.89	30,940,205	.011	.25
Wyoming	31,908	.012	.35	1,066,178	.024	.16	1,180,662	.040	.27
							6	3.333	.50
East									
	767,290	.010	.99	6,728,515	.016	1.75	94,636,956	.009	.36
Eastern States:									
	2,238,144			832,139	(?)	.05	381,574	.041	.02
							4,202,461	.001	.03
	3,005,434	.003	.25	7,560,654	.014	1.56	99,220,991	.009	.35

¹Excludes Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.

²Less than 0.005 ounce per ton.

³Excludes zinc-copper and zinc-lead-copper ore from Arizona.

⁴Includes 115,281 tons of zinc slag from which silver was recovered.

⁵Includes 157,968 tons of zinc slag from which silver was recovered.

⁶Includes 6,990 tons of zinc slag from which gold and silver were recovered.

⁷Excludes magnetite-pyrite-chalcoppyrite ore from Pennsylvania.

the "porphyry coppers") and ores from which separate products of lead concentrates and zinc concentrates are made. The crude ore into the mill in these two exceptional instances thus takes its name from its products—a name that is also justified by the mineralogical content and final recovery of metals. The "dry and siliceous ores" thus, by elimination, include both dry siliceous and iron, but chiefly siliceous, ores valuable for their gold and silver content, regardless of method of treatment, and dry fluxing ores carrying considerable quantities of iron and manganese oxides, or iron sulfide, and very small quantities of gold and silver. Dry and siliceous gold ores are those that by inspection are overwhelmingly of gold content; a similar qualification applies to silver ores; decision as to "gold-silver" ore is made arbitrarily on a basis of value, using the rule that the metal of lower value is not used in the bimetal classification unless its value is equal to or over one-quarter of the combined value of the gold and silver.

The lead, zinc, and zinc-lead ores in most districts in the Eastern and Central States carry no appreciable quantity of gold or silver; such ores are excluded from this report unless otherwise indicated.

Mine production of gold in the United States in 1944, by States and sources, in fine ounces, in terms of recovered metals ¹

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores	Total
Alaska.....	33,611	15,685						49,296
Arizona.....	242	10,791	91,113	1,400		14	8,602	112,162
California.....	75,049	32,257	3,399	1,948		3,988	732	117,373
Colorado.....	343	92,706	91	1,313		167	16,835	111,455
Georgia.....	5							5
Idaho.....	136	13,405	236	365		89	10,777	25,008
Montana.....	6,223	25,640	13,183	926		35	4,014	50,021
Nevada.....	7,353	53,306	54,593	503		3,111	190	119,056
New Mexico.....	8	1,466	2,543	636		2	2,263	6,918
North Carolina.....			21					21
Oregon.....	293	1,076						1,369
Pennsylvania.....			2,115					2,115
South Dakota.....		11,495					126	11,621
Tennessee.....			222					222
Texas.....								
Utah.....		19,488	286,013	2,169		33	36,520	344,223
Vermont.....			100					100
Virginia.....							132	132
Washington.....	59	20,636	4			377	26,201	47,277
Wyoming.....		20						20
	123,322	297,971	453,633	9,260		7,816	106,392	998,394

¹ Philippine Islands and Puerto Rico excluded.

² From magnetite-pyrite-chalcopryrite ore.

³ No ore treated; bullion produced in clean-up at Homestake mill.

Mine production of silver in the United States in 1944, by States and sources, in fine ounces, in terms of recovered metals ¹

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores	Total
Alaska.....	4,192	9,170						13,362
Arizona.....	90	192,498	3,106,402	81,894		8,126	1,005,029	4,394,039
California.....	4,531	74,776	24,411	299,599		194,120	181,499	778,936
Colorado.....	90	1,186,036	27,286	90,844		3,544	941,030	2,248,830
Idaho.....	31	2,354,006	3,854	3,179,646	8,307	75,221	4,310,549	9,931,614
Illinois.....							2,437	2,437
Michigan.....			54,218					54,218
Missouri.....				92,243				92,243
Montana.....	495	618,384	5,515,268	66,283		79,912	812,873	7,093,215
Nevada.....	2,904	241,344	348,267	163,428		377,945	125,748	1,259,636
New Mexico.....		62,835	115,261	20,279		1,244	335,656	535,275
New York.....							25,238	25,238
North Carolina.....			1,461					1,461
Oregon.....	38	20,205						20,243
Pennsylvania.....			13,545					13,545
South Dakota.....		2,668					2,777	5,445
Tennessee.....			45,907					45,907
Texas.....		4,086	1,269					5,355
Utah.....		1,005,886	2,565,851	142,265		12,241	3,866,832	7,593,075
Vermont.....			18,862					18,862
Virginia.....			962				18,031	18,993
Washington.....	7	134,365	322	569		11,069	175,276	321,608
Wyoming.....		3						3
	12,378	5,906,262	11,843,146	4,137,050	8,307	763,422	11,802,975	34,473,540

¹ Philippine Islands and Puerto Rico excluded.

² From magnetite-pyrite-chalcopryrite ore.

³ No ore treated; bullion recovered from clean-up at Homestake mill.

Gold and silver produced in the United States from ore and old tailings, in 1944, by States and by methods of recovery, in terms of recovered metals:

State	Total ore and old tailings, etc., treated (short tons)	Ore and old tailings to amalgamation and cyanidation mills and bullion recovered				Ore and old tailings to concentrating mills (short tons)	Concentrates smelted (from amalgamation and cyanidation and concentrating mills combined)			Crude ore to smelters		
		Ore (short tons)	Old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)		Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)
Western States and Alaska:												
Alaska.....	381,574	381,574		12,601	2,901	31,543,180	208	3,084	6,599	1,280,989	50,554	2,019,515
Arizona.....	32,156,505	20,561			1,767	733,912	1,215,175	60,710	2,372,967	4	344	386,487
California.....	925,933	149,471	3,370	23,904	15,613	12,793,912	86,953	14,890	4,329	34,813	1,551	106,427
Colorado.....	1,550,422	890,913		42,311	23,923	3,140,183	339,103	20,892	9,839,651	87,281	1,551	100,702
Idaho.....	3,271,038	43,625		2,429	1,230	2,140,755	331,226	21,386	6,248,171	174,068	16,396	100,702
Montana.....	6,040,463	50,935		6,016	1,535	6,569,756	268,222	57,964	7,065,831	174,068	16,396	100,702
Nevada.....	6,863,505	411,088	260	45,318	45,967	6,278,099	346,155	4,081	389,059	174,068	16,396	100,702
New Mexico.....	7,943,846					7,850,208	91	37	4,559	1,701	14,848	
Oregon.....	4,217	509	1,000	338	868	925	225	126	2,777	1,701	14,848	
South Dakota.....	2,839	(7)		11,468	2,668	2,839						
Texas.....	4,160											
Utah.....	30,940,205					30,632,016	1,075,694	323,551	6,430,644	4,160	5,355	
Washington.....	1,180,663	42,245		2,062	11,964	1,118,318	62,184	42,753	293,115	1,308,189	21,573	1,163,431
Wyoming.....	6									20,099	20	8
Eastern States.....												
Illinois.....	91,274,394	1,990,891	4,630	150,240	109,076	87,494,132	4,070,102	612,896	28,724,940	2,445,270	109,346	5,354,262
Michigan.....	4,202,461					4,059,888	88,473	2,530	107,737	142,473	60	16,260
Missouri.....	93,476,855	1,990,891	4,630	150,240	109,076	91,554,120	4,158,575	615,426	28,832,677	2,588,743	109,406	5,370,511

- 1 Includes Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.
- 2 Excludes 3,131,360 tons of copper ore leached from which no gold or silver was recovered.
- 3 Includes 14,814 tons of copper precipitates from which silver was recovered.
- 4 Includes 10,457 tons of old tailings.
- 5 Includes 139 tons of lead fume and 6,150 tons of zinc fume from which silver was recovered.
- 6 Includes 48,880 tons of slag from which gold and silver were recovered.
- 7 No ore treated; bullion produced in clean-up at Homestake mill.
- 8 Includes 187,988 tons of slag fumed from which silver was recovered.
- 9 Excludes copper ore leached from Arizona; includes slag from Montana and Utah.
- 10 Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania, on which the Bureau of Mines is not at liberty to publish data.
- 11 Excludes copper ore leached from Arizona; includes slag from Montana and Utah; excludes magnetite ore from Pennsylvania.

Gold and silver produced at amalgamation and cyanidation mills in the United States and percentage of gold and silver recovered from all sources, 1940-44¹

Year	Bullion and precipitates recovered (fine ounces)				Percent of gold and silver from all sources ²							
	Amalgamation		Cyanidation		Amalgamation		Cyanidation		Smelting ³		Placers	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1940.....	959,452	248,112	1,044,014	5,251,182	19.7	0.3	21.4	7.5	27.9	91.9	31.0	0.3
1941.....	916,113	214,665	1,005,031	5,157,702	19.3	.3	21.1	7.7	28.3	91.7	31.3	.3
1942.....	623,319	140,192	698,817	3,008,490	18.0	.2	20.2	5.6	32.5	93.9	29.3	.3
1943.....	168,772	44,114	143,092	420,528	12.4	.1	10.5	1.0	65.5	98.9	11.6	(⁴)
1944.....	73,974	18,067	76,266	91,009	7.4	(⁴)	7.6	.3	72.6	99.7	12.4	(⁴)

¹ Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.

² Both crude ores and concentrates.

³ Less than 0.1 percent.

Gold and silver produced at amalgamation and cyanidation mills in the United States in 1944, by States¹

State	Amalgamation			Cyanidation			Percent of gold and silver from all sources in State			
	Ore, old tailings, concentrates, etc., treated (short tons)	Bullion recovered (fine ounces)		Ore, old tailings, concentrates, etc., treated (short tons)	Bullion and precipitates recovered		Amalgamation		Cyanidation	
		Gold	Silver		Gold	Silver	Gold	Silver	Gold	Silver
Alaska.....	381,574	12,601	2,601	30,443	656	1,767	25.56	19.47	.....	.....
Arizona.....	125,193	14,752	2,722	27,648	9,242	12,791	12.57	.35	7.87	1.64
California.....	810,091	35,323	7,510	200,014	6,988	16,413	31.69	.33	6.27	.73
Colorado.....	43,625	2,429	1,230	9	50,430	5,879	1,526	.27	(⁴)	11.8
Idaho.....	505	137	9	410,265	47,187	44,152	.95	.22	39.63	3.51
Montana.....	1,053	1,131	2,835	.....	.....	.....	.....	.....	.....	.....
Nevada.....	425	129	47	1,084	209	851	9.42	.23	15.27	4.20
New Mexico.....	(⁴)	7,472	1,113	(⁴)	4,023	1,555	64.31	20.44	34.62	28.56
Oregon.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
South Dakota.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Texas.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Utah.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Washington.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wyoming.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Eastern States.....	1,362,466	73,974	18,067	762,129	76,266	91,009	7.41	.05	7.64	.26

¹ Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.

² Comprises 113,869 tons of sands and slimes from ore first roasted and amalgamated and 86,145 tons of selective-flotation tailings.

³ Less than 0.005 percent.

⁴ No ore treated; bullion produced in clean-up at Homestake mill.

PLACERS

Most of the placer gold produced is obtained from gravels handled by connected-bucket floating dredges. In 1944 this method recovered 69 percent of the total output from placers in the United States compared with 69 percent in 1943. The quantity of gold recovered by dredges from the inception of the industry as a commercial factor in 1860 to the end of 1944 is recorded as 19,285,976 ounces, originating in States as follows: California, 11,698,840 ounces; Alaska, 5,202,898 ounces; including the production from single-dipper dredges and some gold dredging by hydraulicking; Montana, 708,244; Idaho, 612,271; Colorado, 552,195; Oregon, 467,046; other States, 141,487.

The following table shows the gold produced in the United States by connected-bucket floating dredges in 1940-44.

Additional information on placer mining may be found in the State reviews in this volume.

Gold produced in the United States by connected-bucket floating dredges, 1940-44, in fine ounces

Year	Dredges	California	Alaska	Other States ¹	Total
1940	122	414,966	354,806	134,377	904,149
1941	123	418,282	307,087	141,636	867,005
1942	102	310,937	249,868	128,264	689,069
1943	21	66,999	18,554	24,373	109,926
1944	19	64,925	26,280	10,774	101,979

¹ Colorado, Idaho, Montana, Nevada, and Oregon.

EMPLOYMENT AND PRODUCTION IN 1943

Many of the trends characterizing the industry in 1942 continued at an accelerated pace in 1943. The number of mines producing gold and silver ores, the men employed and the man-hours of labor performed declined 70 percent from 1942; operating days per mine increased from 248 days in 1942 to 279 in 1943; average workyear per man from 1,986 man-hours to 2,231, and tons of ore produced per mine from 6,334 to 7,474; man-hours per ton of ore mined declined from 2.19 to 2.15.

State or region	Production				Manufactures			
	Ore (short tons)		Gold (fine ounces)	Silver (fine ounces)	Total value of base metals recovered)	Percent of total value from—		Per ounce of gold and silver
	Produced	Milled				Gold	Base metals	
Western States:								
Arizona.....	138, 144	124, 947	23, 019	48, 540	\$959, 097	84.0	12.4	
California (including State gold-silver ore).....	412, 262	401, 527	50, 170	141, 236	1, 884, 265	93.1	1.6	8.67
Colorado.....	885, 838	881, 804	113, 936	540, 481	5, 426, 257	73.5	19.4	4.81
Idaho.....	65, 352	61, 370	16, 313	58, 476	654, 003	87.3	6.3	4.14
Montana.....	72, 616	47, 592	21, 294	26, 069	809, 560	92.9	4.8	2.51
Nevada.....	377, 022	373, 160	50, 960	53, 386	1, 831, 726	97.4	4.5	1.53
New Mexico.....	200	882	885	10, 492	31, 165	99.1	.4	5.30
Oregon.....	2, 646	1, 851	885	32, 823	39, 777	77.9	3.3	3.94
South Dakota (including Eastern States).....	202, 174	202, 018	106, 536		3, 752, 231	99.4	1.68	2.80
Texas (including with State silver ore).....	68, 085		16, 992	80, 645	944, 582	63.0	31.0	2.00
Utah.....	61, 002	51, 135	22, 927	173, 115	927, 109	86.5	2.55	1.05
Washington.....								.66
Alaska.....								.57
Eastern States (included with South Dakota).....	2, 285, 441	2, 146, 544	423, 914	1, 165, 489	17, 259, 772	86.0	9.2	.81
	1, 483, 519	1, 483, 519	57, 453	37, 634	2, 073, 064	97.0	.3	.20
Total, 1942.....	3, 768, 960	3, 629, 063	481, 367	1, 203, 123	19, 332, 836	87.2	8.4	1.75
Total, 1941.....	9, 450, 847	9, 287, 408	1, 601, 262	2, 155, 261	58, 253, 512	96.2	1.2	1.93
Total, 1941.....	15, 117, 117	14, 843, 603	2, 403, 134	3, 478, 518	87, 437, 933	96.2	1.0	.48

See footnote at end of table.

Employment and production in gold and silver lode mines and mills in the United States in 1943, by classes of ore and by States, or regions—Con.

GOLD-SILVER ORE

State or region	Number of mines	Employment							
		Average number of men				Man-hours			
		Mine		Mll	Total	Mine		Mll	Total
		Under-ground	Surface ¹			Under-ground	Surface ¹		
Western States:	12	36	5	41	42	77,816	10,784	88,600	88,638
Arizona.....	8	46	7	53	78	97,397	13,632	111,029	161,749
California (included with State gold ore).....	3	64	160	224	83	165,282	480,266	645,548	830,287
Colorado.....	24	65	14	79	80	146,485	19,740	166,225	234,739
Idaho.....	16	81	11	92	16	179,550	22,867	202,417	166,575
Montana.....	3	6	1	7	7	11,950	760	12,700	237,801
Nevada.....	30	147	45	192	192	276,515	100,812	377,327	12,700
New Mexico.....									377,327
Utah.....									
Washington (included with State silver ore).....									
Total, 1942.....	96	445	243	688	814	954,995	598,851	1,553,846	1,875,077
Total, 1941.....	215	1,085	321	1,406	1,702	2,246,326	698,297	2,934,623	3,543,140
Total, 1941.....	435	2,225	590	2,815	3,203	3,834,237	1,050,910	4,885,147	5,837,377

State or region	Ore (short tons)		Gold (fine ounces)	Silver (fine ounces)	Total value (including value of base metals recovered)	Percent of total value from—			Man-hours			Per ounce of gold and silver	
	Produced					Milled	Gold	Silver	Base metals	Mined	Milled		Per ton of ore
Western States:													
Arizona	23,662	28	2,097	91,154	\$203,261	36.1	31.9	32.0	3.74	1.36	0.95	0.36	
California (included with State gold ore)	30,105	28,684	3,152	112,726	266,938	41.3	30.0	28.7	3.69	1.77	.96	.46	
Colorado	178,749	178,747	5,486	173,836	315,627	60.8	39.2	3.1	3.33	1.31	3.32	1.31	
Idaho	53,890	117	3,874	267,433	308,268	34.1	47.7	18.2	3.08	2.99	.61	.29	
Montana	51,283	39,764	5,746	285,273	416,439	48.3	50.4	1.3	3.95	.89	.67	.53	
Nevada	904		716	47,880	89,593	42.1	56.5	1.4	14.05		.26		
New Mexico	212,039		13,527	705,077	1,484,840	31.9	33.8	34.3	1.78		.53		
Utah													
Washington (included with State silver ore)													
	550,642	247,340	34,598	1,692,879	3,144,906	38.5	38.3	23.2	2.82	1.30	.90	.81	
Total, 1942	1,203,736	809,445	114,714	4,404,269	8,265,830	48.6	37.9	13.5	2.44	.75	.65	.27	
Total, 1941	1,447,375	992,038	162,810	7,149,036	11,849,973	48.1	42.9	9.0	3.38	.96	.67	.23	

See footnote at end of table.

Mine production of gold in the United States in 1944, by States and sources, in fine ounces, in terms of recovered metals ¹

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores	Total
Alaska.....	33,611	15,685						49,296
Arizona.....	242	10,791	91,113	1,400		14	8,602	112,162
California.....	75,049	32,257	3,399	1,948		3,988	732	117,373
Colorado.....	343	92,706	91	1,313		167	16,835	111,455
Georgia.....	5							5
Idaho.....	136	13,405	236	365		89	10,777	25,008
Montana.....	6,223	25,640	13,183	926		35	4,014	50,021
Nevada.....	7,353	53,306	54,593	503		3,111	190	119,056
New Mexico.....	8	1,466	2,543	636		2	2,263	6,918
North Carolina.....			21					21
Oregon.....	293	1,076						1,369
Pennsylvania.....			2,115					2,115
South Dakota.....		11,495					126	11,621
Tennessee.....			222					222
Texas.....								
Utah.....		19,488	286,013	2,169		33	36,520	344,223
Vermont.....			100					100
Virginia.....							132	132
Washington.....	59	20,636	4			377	26,201	47,277
Wyoming.....		20						20
	123,322	297,971	453,633	9,260		7,816	106,392	998,394

¹ Philippine Islands and Puerto Rico excluded.

² From magnetite-pyrite-chalcocopyrite ore.

³ No ore treated; bullion produced in clean-up at Homestake mill.

Mine production of silver in the United States in 1944, by States and sources, in fine ounces, in terms of recovered metals ¹

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores	Total
Alaska.....	4,192	9,170						13,362
Arizona.....	90	192,498	3,106,402	81,894		8,126	1,005,029	4,394,039
California.....	4,531	74,776	24,411	299,599		194,120	181,499	778,936
Colorado.....	90	1,186,036	27,286	90,844		3,544	941,030	2,248,830
Idaho.....	31	2,354,006	3,854	3,179,646	8,307	75,221	4,310,549	9,931,614
Illinois.....							2,437	2,437
Michigan.....			54,218					54,218
Missouri.....				92,243				92,243
Montana.....	495	618,384	5,515,298	66,293		79,912	812,873	7,093,215
Nevada.....	2,904	241,344	348,267	163,428		377,945	125,748	1,259,636
New Mexico.....		62,835	115,261	20,279		1,244	335,656	535,275
New York.....							25,238	25,238
North Carolina.....			1,461					1,461
Oregon.....	38	20,205						20,243
Pennsylvania.....			13,545					13,545
South Dakota.....		2,668					2,777	5,445
Tennessee.....			45,907					45,907
Texas.....		4,086	1,269					5,355
Utah.....		1,005,886	2,565,851	142,265		12,241	3,866,832	7,593,075
Vermont.....			18,862					18,862
Virginia.....			962				18,031	18,993
Washington.....	7	134,365	322	569		11,069	175,276	321,606
Wyoming.....		3						3
	12,378	5,906,262	11,843,146	4,137,050	8,307	763,422	11,802,975	34,473,540

¹ Philippine Islands and Puerto Rico excluded.

² From magnetite-pyrite-chalcocopyrite ore.

³ No ore treated; bullion recovered from clean-up at Homestake mill.

Gold and silver produced in the United States from ore and old tailings, in 1944, by States and by methods of recovery, in terms of recovered metals¹

State	Total ore and old tailings, etc., treated (short tons)	Ore and old tailings to amalgamation and cyanidation mills and bullion recovered				Ore and old tailings to concentrating mills (short tons)	Concentrates smelted (from amalgamation and cyanidation and concentrating mills combined)				Crude ore to smelters		
		Ore (short tons)		Silver (fine ounces)			Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)	
		Ore (short tons)	Old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)								
Western States and Alaska:													
Alaska.....	381,574	381,574		12,601	2,601	31,543,180	208	3,084	6,569				
Arizona.....	2 32,156,505	29,561		656	1,767	733,912	86,953	60,710	2,372,967	50,554	2,019,515		
California.....	925,953	149,471	3,370	23,994	15,513	733,912	142,856	14,890	403,909	3,440	354,986		
Colorado.....	1,550,422	890,913		42,311	23,923	624,696	339,103	64,472	2,028,890	4,329	196,427		
Idaho.....	3,271,038	43,625		2,311	1,230	3,140,183	298,222	20,892	9,326,651	1,551	100,702		
Montana.....	6,049,462	50,935		6,016	1,535	5,569,756	331,226	21,386	6,248,171	16,396	843,014		
Nevada.....	6,863,505	411,058	260	48,318	46,987	6,278,099	298,222	57,994	706,531	5,421	603,214		
New Mexico.....	7,943,846					7,850,208	346,165	4,031	389,059	83,638	146,216		
Oregon.....	4,217	509	1,000	338	898	2,839	91	37	4,459	1,783	701		
South Dakota.....	2,839	(7)		11,495	2,668	2,839	225	126	2,777				
Texas.....	4,160												
Utah.....	30,940,205					30,632,016	1,076,694	322,551	2,777	4,160	5,355		
Washington.....	1,180,662	42,245		2,082	11,954	1,118,318	62,184	42,753	293,644	7,308,189	21,672	1,153,431	
Wyoming.....	6									20,099	2,383	16,531	3
Eastern States:													
Illinois.....	91,274,394	1,999,891	4,630	150,240	109,076	87,494,132	4,070,102	612,896	28,724,940	2,446,270	109,346	5,354,242	
Michigan.....	4,202,461	1,999,891	4,630	150,240	109,076	4,059,988	88,473	2,530	107,737	142,473	60	16,269	
Missouri.....	93,476,855					91,554,120	4,158,575	615,426	28,832,677	2,588,743	109,406	5,370,511	

¹ Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.² Excludes 3,131,340 tons of copper ore leached from which no gold or silver was recovered.³ Includes 14,814 tons of copper precipitates from which silver was recovered.⁴ Includes 10,457 tons of old tailings.⁵ Includes 139 tons of lead fume and 6,150 tons of zinc fume from 37,175 tons of zinc slag fumed.⁶ Includes 48,880 tons of slag from which gold and silver were recovered.⁷ No ore treated; bullion produced in clean-up at Homestake mill.⁸ Includes 187,988 tons of slag fumed from which silver was recovered.⁹ Excludes copper ore leached from Arizona; includes slag from Montana and Utah.¹⁰ Excludes magnetite-pyrite-chalcocopyrite ore from Pennsylvania, on which the Bureau of Mines is not at liberty to publish data.¹¹ Excludes copper ore leached from Arizona; includes slag from Montana and Utah; excludes magnetite ore from Pennsylvania.

Employment and production in gold and silver lode mines and mills in the United States in 1943, by classes of ore and by States or regions—Con.

SILVER ORE

State or region	Number of mines	Employment									
		Average number of men				Man-hours					
		Mine			Total	Mine			Mill	Total	
		Under-ground	Surface ¹	Total		Under-ground	Surface ¹	Total			
Western States:											
Arizona.....	16	48	9	57	1	106,225	20,840	127,065	325	127,410	
California.....	9	9	9	9	9	2,000	—	2,000	—	2,000	
Colorado.....	16	116	30	146	23	289,292	62,266	351,558	52,770	404,328	
Idaho.....	15	397	111	508	109	926,498	263,327	1,189,825	263,368	1,454,193	
Montana.....	47	148	39	187	23	316,496	90,336	406,832	45,596	450,428	
Nevada.....	19	57	8	65	14	92,160	13,689	105,849	25,200	129,049	
New Mexico.....	3	6	1	7	7	7,620	1,680	9,300	—	9,300	
Texas (including State gold ore).....	6	8	1	9	1	15,500	1,500	17,000	80	17,080	
Utah.....	28	102	29	131	132	235,524	68,936	304,460	200	304,660	
Washington (including State gold—silver ore).....	4	4	4	4	5	1,440	—	1,440	200	1,640	
Total, 1942.....	163	895	228	1,123	1,295	1,991,765	522,594	2,514,349	385,739	2,900,088	
Total, 1941.....	234	1,618	385	2,003	2,222	3,452,770	849,866	4,302,636	459,778	4,762,414	
Total, 1941.....	425	2,218	397	2,615	2,829	3,989,972	711,616	4,701,588	499,565	5,196,854	

State or region	Ore (short tons)		Gold (fine ounces)	Silver (fine ounces)	Total value (including value of base metals recovered)	Percent of total value from—			Per ton of ore		Per ounce of gold and silver	
						Gold	Silver	Base metals	Mined	Milled	Mined	Milled
	Produced	Milled										
Western States:												
Arizona.....	24,379	270	768	246,515	\$203,064	13.1	85.5	1.4	5.21	1.20	0.51	0.30
California.....	78,883	58,524	625	1,890	3,508	2.2	38.3	61.7	4.64	—	1.06	—
Colorado.....	287,344	276,885	175	975,466	977,987	6.9	70.9	28.9	4.46	—	—	—
Idaho.....	140,466	30,668	2,218	4,596,079	3,268,323	8.4	88.8	11.0	4.14	—	—	—
Montana.....	33,890	20,983	1,022	1,095,568	1,280,693	8.4	63.4	29.7	2.90	1.42	—	—
Nevada.....	3,812	—	35	333,031	430,765	9.6	55.0	36.6	2.13	1.11	—	—
New Mexico.....	3,640	39	4	14,013	13,014	7.7	76.6	14.0	5.13	—	—	—
Texas (including State gold ore).....	72,331	100	—	10,031	24,092	7.7	38.4	71.0	4.67	2.05	—	—
Utah.....	218	100	1,874	716,979	850,939	4.2	69.9	32.4	4.21	2.00	—	—
Washington (including State gold—silver ore).....	643,394	387,849	6,728	7,901,521	1,060	3.4	81.4	31.7	6.61	2.00	1.60	—
Total, 1942.....	994,117	726,324	13,660	13,597,461	6,905,453	4.1	82.4	15.2	3.91	—	—	—
Total, 1941.....	1,074,539	809,536	16,572	16,981,973	11,733,717	4.2	86.5	9.3	4.32	—	—	—
					13,963,695				4.38	—	—	—

See footnote at end of table.

Employment and production in gold and silver lode mines and mills in the United States in 1943, by classes of ore and by States or regions—Con.

SUMMARY

State or region	Number of mines	Employment									
		Average number of men				Man-hours					
		Mine		Mill	Total	Mine		Mill	Total		
		Under-ground	Surface ¹			Under-ground	Surface ¹				
		Under-ground	Surface ¹	Total	Under-ground	Surface ¹	Total				
Western States:											
Arizona.....	84	295	49	344	103	447	720,208	116,020	836,228	205,233	1,041,461
California.....	101	338	138	496	93	589	628,585	293,716	922,301	211,745	1,124,046
Colorado.....	86	1,013	418	1,431	347	1,778	2,470,832	698,862	3,169,694	801,587	3,971,281
Idaho.....	43	539	282	821	222	1,043	1,254,927	716,935	1,971,862	568,092	2,539,954
Montana.....	141	322	75	397	66	463	680,347	142,678	823,025	117,188	940,213
Nevada.....	87	240	103	343	151	494	489,583	229,529	719,112	378,132	1,097,244
New Mexico.....	11	16	3	19	20	40	20,409	2,590	22,999	280	23,279
Oregon.....	15	14	1	15	4	19	8,374	1,000	9,374	1,940	11,314
South Dakota (incl. Eastern States).....	3	107	55	162	70	232	227,461	112,831	340,292	133,817	474,109
Texas.....	6	8	1	9	10	10	16,509	1,500	17,009	80	17,080
Utah.....	69	341	93	434	1	435	725,509	215,392	940,901	200	941,101
Washington.....	11	60	13	73	11	84	126,392	30,357	156,749	29,327	186,076
Alaska.....	657	3,313	1,231	4,544	1,070	5,614	7,308,127	2,561,410	9,929,537	2,447,621	12,377,158
Eastern States (incl. with South Dakota).....	7	182	117	299	107	406	438,948	307,936	746,884	292,486	1,039,370
Total, 1942.....	664	3,495	1,348	4,843	1,177	6,020	7,807,075	2,869,346	10,676,421	2,740,107	13,416,528
Total, 1941.....	1,839	9,862	2,945	12,827	2,970	15,797	19,495,759	6,973,130	25,468,889	6,095,231	31,564,120
Total, 1941.....	3,632	17,941	6,011	23,952	3,748	27,700	34,007,171	11,906,650	45,913,821	8,625,990	54,139,811

State or region	Ore (short tons)		Gold (fine ounces)	Silver (fine ounces)	Total value (total value of base metals recovered)	Percent of total value from—		MILL-HOURS			
								Per ton of ore		Per ounce of gold and silver	
	Produced	Milled				Gold	Silver	Base metals	Mined	Milled	Mined
Western States:											
Arizona.....	186,185	125,245	25,884	380,209	\$1,367,422	66.3	20.1	13.6	4.49	1.64	2.03
California.....	412,793	401,527	60,140	143,126	1,887,771	93.8	17.4	1.9	2.23	2.77	4.68
Colorado.....	994,826	911,488	117,713	1,628,673	6,671,032	91.8	17.4	20.7	3.11	.53	1.26
Idaho.....	531,445	516,982	21,974	4,828,391	2,652,037	16.5	73.8	8.1	3.81	1.82	.49
Montana.....	266,972	78,377	27,384	1,300,100	2,337,461	41.0	38.1	19.4	3.08	1.50	.61
Nevada.....	462,175	433,907	57,734	681,710	2,678,930	73.4	18.1	6.2	7.56	.97	.93
New Mexico.....	2,016	140	1,633	61,619	103,772	55.1	42.2	2.7	7.89	36	3.37
Oregon.....	2,046	1,851	885	10,492	39,777	77.9	18.8	3.3	3.54	2.00	.82
South Dakota (Incl. Eastern States).....	202,174	202,018	106,536	32,823	3,752,231	99.4	6	---	1.08	.66	.66
Texas.....	3,640	39	4	10,031	25,092	6	28.4	71.0	4.67	2.03	1.70
Utah.....	332,475	100	32,393	1,502,701	3,280,361	34.6	32.6	32.8	2.67	.61	6.25
Washington.....	61,220	51,235	22,930	174,014	928,169	86.5	13.3	.2	2.36	.57	.16
Alaska.....	3,479,467	2,722,909	465,210	10,739,889	27,724,215	58.7	27.6	13.7	2.85	.90	.88
Eastern States (Incl. with South Dakota).....	1,483,519	1,483,519	57,453	37,634	2,073,064	97.0	2.7	.3	.50	.20	7.83
Total, 1942.....	4,962,986	4,206,428	522,603	10,797,823	29,797,279	61.4	26.8	12.8	2.15	.65	.94
Total, 1941.....	11,648,700	10,823,151	1,729,636	20,156,991	78,253,071	77.4	18.3	4.3	2.19	.66	.38
Total, 1941.....	17,639,031	16,645,477	2,582,516	27,009,527	113,251,601	79.8	17.3	2.9	2.00	.52	.38

¹ Includes open-cut workers.

Employment and production in gold placer mines in the United States in 1943

State or region	Number of mines	Employment					Production			
		Average number of men		Man-hours			Gold (ounces)	Silver (ounces)	Total value	Man-hours per ounce of gold and silver
		Dredg- ing	Hydrau- licking	Other ¹	Total	Dredg- ing	Hydrau- licking	Other	Total	
Western States:	19			13	13			4,856		
Arizona.....	82	264	51	230	545	599,514	70,761	408,870	1,077,145	319
California.....	17			17	18		990	12,144	10,774	89,438
Colorado.....	30		1	34	38		2,110	30,132	14,072	5,922
Idaho.....	45	47	1	42	90	51,144	900	20,536	1,350	90
Montana.....	17	44		23	67	82,530		2,160	4,484	1,350
Nevada.....	16			12	12			4,822	14,802	25
New Mexico.....	16	3	17	15	35	600	9,480	3,248	120	208
Oregon.....	3	3		3	6					18.1
Utah and Washington.....										28.1
Alaska.....	245	381	74	389	844	764,388	84,211	508,640	1,357,239	116,241
Eastern States.....	114	282	177	92	551	404,238	141,600	116,400	562,238	42,111
	3			3	3			480	480	12
Total, 1942.....	362	663	251	484	1,398	1,168,626	225,811	625,520	2,019,857	158,364
Total, 1941.....	1,758	5,039	1,003	2,375	8,417	5,258,074	878,484	2,997,433	12,134,010	1,013,762
	3,240	8,216	2,021	3,131	13,368	14,366,103	1,868,704	2,941,130	19,176,940	1,457,635
										17,121
										17,121
										140,869
										164,128
										5,554,915
										85,881,843
										82,205,272
										11.5
										10.6
										11.4

¹ Includes employees in underground placers, small-scale hand operations, and surface shops and yards.

Employment and production for gold and silver mines in the United States in 1942
 SUMMARY

State or region	Number of mines	Employment		Gold (ounces)	Silver (ounces)	Total value of base metals recovered	Percent of total value from—			Man-hours per ounce of gold and silver mined
		Men	Man-hours				Gold	Silver	Base metals	
Western States:										
Arizona.....	103	357	841,084	26,203	386,223	\$1,378,597	66.5	19.9	13.6	2.04
California.....	183	1,061	1,999,446	139,565	149,118	6,021,907	97.3	2.1	6	6.93
Colorado.....	103	1,449	3,184,798	118,234	1,628,763	6,689,461	61.9	17.3	20.8	1.82
Idaho.....	73	859	1,986,824	22,229	4,828,460	4,661,011	10.7	73.7	8.6	.41
Montana.....	186	487	944,221	41,456	1,301,450	2,830,941	51.3	32.7	16.0	.70
Nevada.....	104	410	822,178	68,963	1,686,144	3,075,098	78.5	15.9	6.6	1.09
New Mexico.....	27	31	25,159	1,725	61,644	107,010	56.4	41.0	2.6	4.40
Oregon.....	31	50	24,276	1,093	10,520	47,077	81.3	15.9	2.8	2.09
South Dakota (including Eastern States lodes).....	3	162	340,292	106,536	32,823	3,752,231	99.4	.6	-----	2.44
Texas.....	6	9	17,000	4	10,031	25,092	1	28.4	71.5	.61
Utah (lodes only; placers included with Washington).....	69	434	940,901	32,393	1,502,701	3,280,361	34.6	32.6	32.8	1.69
Washington (including Utah placers).....	14	79	160,597	23,050	174,031	932,381	86.5	13.3	.2	.92
Alaska.....	902	5,388	11,286,776	581,451	10,771,908	31,801,197	64.0	24.1	11.9	.99
Eastern States (placers only; lodes included with South Dakota).....	121	299	1,409,122	99,564	42,736	3,550,577	98.1	.9	1.0	10.90
	3	3	480	12	-----	420	100.0	-----	-----	40.00
Total, 1942.....	1,026	* 5,690	12,696,378	681,027	10,814,644	35,352,194	67.4	21.8	10.8	1.10
Total, 1941.....	3,597	21,244	37,602,899	2,743,898	20,287,860	113,894,914	84.3	12.7	3.0	1.63
Total, 1941.....	7,001	37,320	65,089,761	4,070,151	27,803,655	165,456,873	86.1	11.9	2.0	2.04

WORLD ASPECTS

WORLD PRODUCTION

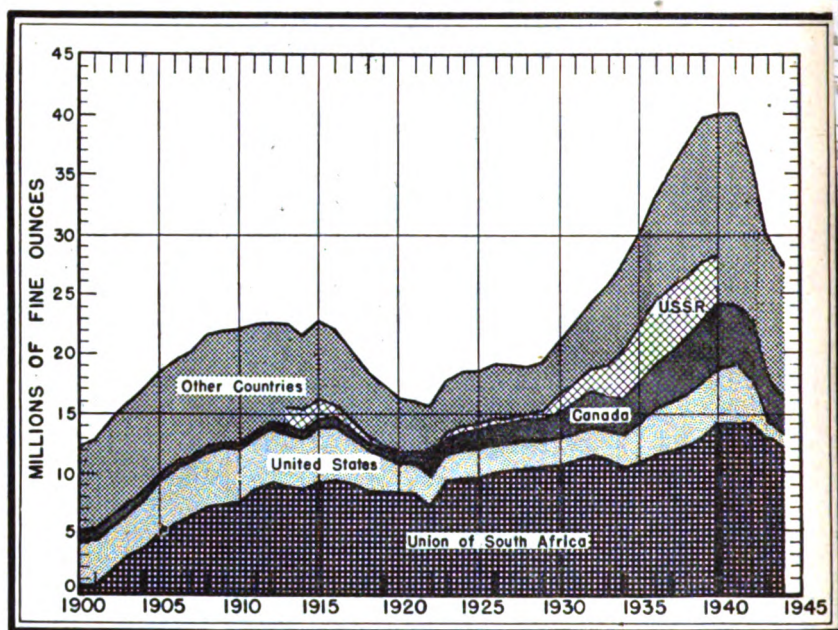


FIGURE 2.—World production of gold, 1900-1944.

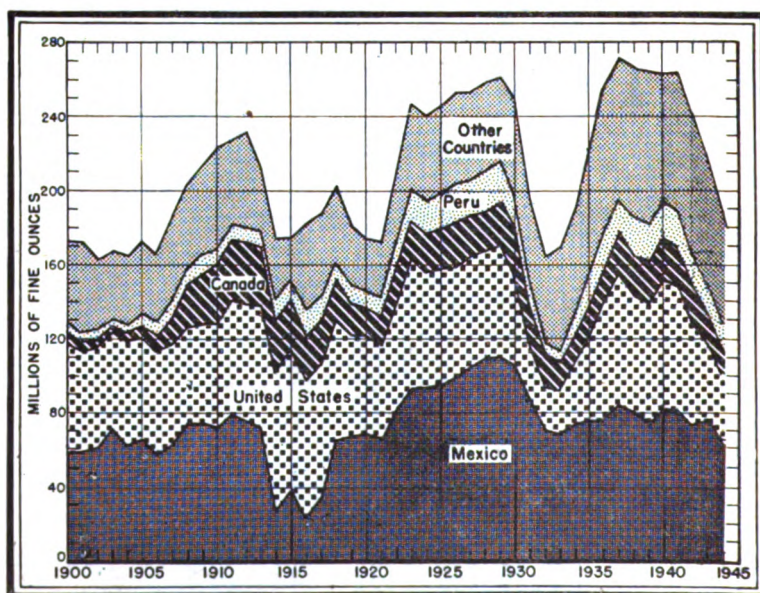


FIGURE 3.—World production of silver, 1900-1944.

World production of gold, 1939-44, by countries, in fine ounces ¹

Country	1939	1940	1941	1942	1943	1944
East America:						
United States (incl. Alaska and Puerto Rico) ²	4,620,602	4,862,979	4,832,087	3,583,080	1,380,768	1,022,238
Canada.....	5,094,379	5,311,145	5,345,179	4,841,306	3,651,301	2,885,474
Central America and West India:						
Costa Rica.....	15,863	16,156	16,891	14,864	6,967	3,606
Cuba.....	3,851	1,251	607	195	51	39
Dominican Republic (exports).....	6,304	6,914	15,614	6,709	816	683
Guatemala.....	5,068	4,447	2,560	729	409	126
Haiti.....	(³)	(³)	(³)	432	810	161
Honduras.....	30,600	37,500	26,800	29,084	20,734	19,774
Nicaragua.....	100,192	168,549	217,771	248,176	223,641	219,349
Panama.....	3,774	2,634	2,106	98		
Salvador.....	16,320	50,425	32,856	31,070	28,411	23,204
Mexico.....	841,642	883,117	799,975	801,367	631,537	506,882
Switzerland.....	20,316	21,786	21,194	15,750	18,735	18,329
	10,759,400	11,367,400	11,816,900	9,572,900	5,963,700	4,701,900
West America:						
Argentina.....	12,249	12,860	17,619	20,994	14,467	(⁴)
Bolivia.....	9,255	11,749	8,158	5,905	4,304	4,561
Brazil.....	252,576	264,311	235,343	229,068	191,300	178,300
Chile.....	368,474	373,544	278,004	253,590	269,807	(⁵)
Colombia.....	570,017	631,927	656,019	596,618	565,501	553,580
Ecuador.....	85,352	71,217	83,375	88,871	90,991	84,234
Guatemala.....						
British.....	38,473	35,745	36,046	29,267	19,470	(⁶)
French.....	37,606	32,561	34,281	25,607	17,726	18,440
Netherlands (Surinam).....						
Peru.....	14,812	15,921	12,563	7,883	5,795	5,723
Uruguay.....	267,355	281,259	285,189	257,610	199,637	175,180
Venezuela.....	1,608	1,762	1,364	(⁷)	(⁸)	(⁹)
	146,008	146,792	90,090	88,150	62,802	59,004
	1,804,900	1,879,600	1,747,000	1,603,600	1,441,500	1,368,000
Europe:						
Belgium.....	6,690	7,330	5,562	(¹⁰)	(¹¹)	(¹²)
Czechoslovakia.....	10,000	9,067	(¹³)	(¹⁴)	(¹⁵)	(¹⁶)
Finland.....	1,822	(¹⁷)	(¹⁸)	(¹⁹)	(²⁰)	(²¹)
France.....	85,000	81,148	59,961	44,336	37,391	16,063
Germany.....	9,600	(²²)	(²³)	(²⁴)	(²⁵)	(²⁶)
Austria.....						
Hungary.....	5,079	(²⁷)	(²⁸)	(²⁹)	(³⁰)	(³¹)
Italy.....	5,000	(³²)	(³³)	(³⁴)	(³⁵)	(³⁶)
Norway.....	50	(³⁷)	(³⁸)	(³⁹)	(⁴⁰)	(⁴¹)
Portugal.....	5,948	10,000	(⁴²)	(⁴³)	(⁴⁴)	(⁴⁵)
Romania.....	153,616	130,286	104,230	82,240	(⁴⁶)	(⁴⁷)
Spain.....	30,000	15,000	(⁴⁸)	(⁴⁹)	(⁵⁰)	(⁵¹)
Sweden.....	216,149	197,995	(⁵²)	270,200	(⁵³)	(⁵⁴)
Switzerland.....	1,447	(⁵⁵)	(⁵⁶)	(⁵⁷)	(⁵⁸)	(⁵⁹)
U. S. S. R.....	5,200,000	(⁶⁰)	(⁶¹)	(⁶²)	(⁶³)	(⁶⁴)
United Kingdom.....	6	(⁶⁵)	(⁶⁶)	(⁶⁷)	(⁶⁸)	(⁶⁹)
Yugoslavia.....	71,503	75,000	(⁷⁰)	(⁷¹)	(⁷²)	(⁷³)
	5,804,000	5,366,000	4,500,000	4,500,000	4,500,000	4,500,000
Asia:						
Burma.....	(⁷⁴)	(⁷⁵)	(⁷⁶)	(⁷⁷)	(⁷⁸)	(⁷⁹)
China.....	(⁸⁰)	478,188	(⁸¹)	(⁸²)	(⁸³)	(⁸⁴)
Manchuria.....	105,000	100,000	(⁸⁵)	(⁸⁶)	(⁸⁷)	(⁸⁸)
Ceylon.....	975,000	1,025,000	(⁸⁹)	(⁹⁰)	(⁹¹)	(⁹²)
India, British.....	16,393	13,621	12,500	(⁹³)	4,165	(⁹⁴)
Indonesia.....	314,615	289,324	285,938	260,302	252,228	228,000
Japan.....	8,070	8,038	(⁹⁵)	(⁹⁶)	(⁹⁷)	(⁹⁸)
Malay States.....	836,000	900,000	(⁹⁹)	(¹⁰⁰)	(¹⁰¹)	(¹⁰²)
Federated.....						
Straits Settlements.....	40,283	35,689	(¹⁰³)	(¹⁰⁴)	(¹⁰⁵)	(¹⁰⁶)
Unfederated.....	8	6	(¹⁰⁷)	(¹⁰⁸)	(¹⁰⁹)	(¹¹⁰)
Netherlands Indies.....	880	479	(¹¹¹)	(¹¹²)	(¹¹³)	(¹¹⁴)
Philippine Islands.....	81,183	89,942	(¹¹⁵)	(¹¹⁶)	(¹¹⁷)	(¹¹⁸)
Siam.....	1,040,146	1,140,126	1,144,332	155,726	13,764	(¹¹⁹)
Sri Lanka.....	17,261	12,285	(¹²⁰)	(¹²¹)	(¹²²)	(¹²³)
Saudi Arabia.....	15,985	31,965	36,531	31,352	42,643	(¹²⁴)
Siam.....	145,000	(¹²⁵)	(¹²⁶)	(¹²⁷)	(¹²⁸)	(¹²⁹)
Thailand (Siam).....	12,711	12,717	(¹³⁰)	(¹³¹)	(¹³²)	(¹³³)
	3,911,000	4,263,000	3,443,000	1,700,000	1,600,000	1,500,000

See footnotes at end of table.

World production of gold, 1939-44, by countries, in fine ounces ¹—Continued

Country	1939	1940	1941	1942	1943	1944
Africa:						
Bechuanaland.....	17,219	18,015	14,509	15,441	12,966	11,000
Belgian Congo.....	522,450	555,404	561,030	499,944	453,300	(9)
Ruanda and Urundi.....	29,386	(9)	(11)	(11)	(11)	(9)
Cameroons French.....	14,566	15,760	20,560	20,762	19,625	18,000
Egypt.....	3,877	7,344	2,868	1,768	890	1,000
French Equatorial Africa.....	53,868	73,576	88,590	83,856	80,296	74,000
French West Africa (ex-ports).....	130,000	133,394	(9)	(9)	(9)	(9)
Gold Coast.....	793,099	886,326	885,110	784,478	565,000	(9)
Kenya Colony.....	77,444	77,243	72,148	56,771	45,118	42,000
Liberia.....	6,536	9,661	20,370	20,700	28,900	18,000
Madagascar.....	14,000	11,580	10,995	8,887	9,183	(9)
Morocco, French.....	7,716	4,180	932	32	2,894	2,900
Nigeria.....	25,794	25,617	(9)	(9)	(9)	(9)
Portuguese East Africa.....	13,386	13,386	13,500	(9)	6,481	(9)
Portuguese West Africa.....	1,636	2,915	3,896	4,061	1,960	1,200
Rhodesia:						
Northern.....	4,645	5,782	3,333	(9)	(9)	(9)
Southern.....	795,613	826,485	790,442	760,030	656,684	592,700
Sierra Leone.....	33,657	32,676	(9)	(9)	(9)	(9)
South-West Africa.....	1,484	1,244	531	231	169	100
Sudan.....	7,510	6,006	5,323	5,196	2,127	1,800
Swaziland.....	963	1,080	568	1,129	2,734	2,100
Tanganyika.....	125,784	143,694	141,560	128,603	69,741	54,800
Uganda.....	15,115	11,060	9,505	(9)	(9)	(9)
Union of South Africa.....	12,821,507	14,096,502	14,407,649	14,120,617	12,800,021	12,277,220
	15,517,000	16,990,000	17,240,000	16,707,000	14,924,000	14,100,000
Oceania:						
Australia:						
Commonwealth ¹²	1,645,697	1,643,999	1,496,698	1,153,787	751,279	657,570
Papua.....	36,118	20,845	14,056	(9)	(9)	(9)
New Guinea, Mandated Territory of.....	246,214	294,794	225,000	(9)	(9)	(9)
Fiji.....	110,000	111,338	118,681	99,667	90,000	(9)
New Zealand.....	178,955	195,665	190,000	165,987	149,150	(9)
	2,216,989	2,266,641	2,044,000	1,431,000	1,000,000	900,000
World total ⁶.....	40,013,000	42,153,000	40,291,000	35,514,000	29,429,000	27,070,000

¹ Preliminary world gold-production table prepared, with revisions and adjustments, by B. B. Waldbauer and J. R. Kelghley, Foreign Minerals Division, Bureau of Mines, in cooperation with the Office of the Director of the Mint. Figures used were derived in part from the Statistical Yearbook of the League of Nations and from the American Bureau of Metal Statistics. No official statistics are issued by Government of U. S. S. R., consequently figures released by the various authorities vary widely and are irreconcilable. In some countries accurate figures are not possible to obtain owing to clandestine trade in gold.

² Refinery production.

³ Imports into United States.

⁴ Exports.

⁵ Data not available. Estimate included in total.

⁶ Approximate production.

⁷ Purchases by the State Central Bank.

⁸ Conjectural figure published by the American Bureau of Metal Statistics (New York), Annual Issue.

⁹ Beginning with 1939, Burmese production included with British India.

¹⁰ Figure published by the Director of the Mint, representing gold of Philippine origin refined but not necessarily mined during the year.

¹¹ Beginning with 1941, production of Ruanda and Urundi included with Belgian Congo.

¹² Exclusive of nonmembers of the Transvaal Chamber of Mines.

¹³ Includes New South Wales, Northern Territory, Queensland, South Australia, Tasmania, Victoria and Western Australia.

World production of silver, 1939-44, by countries, in fine ounces ¹

Country	1939	1940	1941	1942	1943	1944
Latin America:						
Argentina	63,871,972	68,286,535	71,075,932	55,859,658	40,874,060	35,651,049
Bolivia	23,163,629	23,833,762	21,754,408	20,695,101	17,344,569	13,686,502
Latin America and West Indies						
Chile	10,292	7,833	11,969	6,119	1,154	3,506
Colombia	102,915	45,836	27,150	26,238	142,420	42,963
Cuba	4,214,461	3,901,959	3,628,059	3,483,912	3,164,352	3,115,352
Guatemala (exports)	238,430	256,692	272,574	265,179	251,901	248,629
Guatemala (imports)	116,742	168,541	245,522	191,184	202,064	305,922
Honduras	75,870,575	82,640,074	78,363,961	84,864,616	76,633,062	65,460,073
Paraguay	1,421,060	1,494,066	1,657,342	1,106,121	1,258,708	1,163,206
Peru	169,010,000	180,635,000	176,937,000	166,508,000	139,872,000	119,577,000
Central America:						
Costa Rica	4,772,263	3,712,607	2,917,776	2,844,344	(²)	(²)
Costa Rica (exports)	7,241,312	5,628,380	7,348,695	8,121,438	7,299,730	6,797,631
El Salvador	27,594	24,694	21,170	25,733	30,048	28,722
Honduras	1,180,902	1,515,563	1,242,240	1,317,058	1,093,543	(²)
Nicaragua	242,628	260,310	271,115	246,281	209,950	197,323
Panama	104,515	172,292	274,335	261,946	362,013	376,565
Panama British	4,500	(²)	(²)	(²)	(²)	(²)
Spain	18,802,075	19,366,096	15,119,047	16,035,022	14,659,742	15,532,440
U.S.S.R.	32,376,000	30,681,000	27,196,000	28,854,000	26,457,000	26,535,000
Europe (estimated):						
Belgium	13,000	(²)	(²)	(²)	(²)	(²)
Denmark	1,000,000	(²)	(²)	(²)	(²)	(²)
France	61,086	(²)	(²)	(²)	(²)	(²)
Germany	565,000	393,878	336,264	363,818	(²)	99,731
Italy	7,000,000	(²)	(²)	(²)	(²)	(²)
Netherlands	335,000	(²)	(²)	(²)	(²)	(²)
Poland	51,600	(²)	(²)	(²)	(²)	(²)
Sweden	880,000	(²)	(²)	(²)	(²)	(²)
Switzerland	295,787	(²)	(²)	(²)	(²)	(²)
U.S.S.R.	60,000	(²)	(²)	(²)	(²)	(²)
U.S.S.R. (estimated)	16,700	(²)	(²)	(²)	(²)	(²)
U.S.S.R. (estimated)	712,731	500,204	(²)	89,218	101,982	(²)
U.S.S.R. (estimated)	306,493	1,050,365	455,319	143,714	734,902	1,043,420
U.S.S.R. (estimated)	1,122,865	745,894	(²)	(²)	(²)	(²)
U.S.S.R. (estimated)	7,000,000	(²)	(²)	(²)	(²)	(²)
U.S.S.R. (estimated)	70,818	81,496	59,669	47,082	33,885	(²)
U.S.S.R. (estimated)	2,293,634	(²)	(²)	(²)	(²)	(²)
U.S.S.R. (estimated)	21,785,000	(²)	(²)	(²)	(²)	(²)
Asia:						
China	6,175,000	5,745,000	5,460,000	(²)	(²)	(²)
India	200,000	(²)	(²)	(²)	(²)	(²)
Japan	2,600,000	(²)	(²)	(²)	(²)	(²)
Philippines	103,953	58,341	(²)	(²)	(²)	(²)
British Malay States	3,500	(²)	(²)	(²)	(²)	(²)
British Borneo	110,000	(²)	(²)	(²)	(²)	(²)
British India	22,745	23,298	22,930	20,098	18,611	(²)
British India	1,672	1,736	(²)	(²)	(²)	(²)
British India	10,100,000	(²)	(²)	(²)	(²)	(²)
British India	618,028	1,508,166	(²)	(²)	(²)	(²)
British India	1,350,099	1,299,199	1,260,097	231,197	26,061	(²)
British India	700	(²)	(²)	(²)	(²)	(²)
British India (exports)	14,544	35,115	33,801	48,344	56,286	(²)
British India	15,000	(²)	(²)	(²)	(²)	(²)
British India	575,000	575,000	(²)	(²)	(²)	(²)
U.S.S.R. (estimated)	21,780,000	22,868,000	(²)	(²)	(²)	(²)

See footnotes at end of table.

*World production of silver, 1939-44, by countries, in fine ounces*¹—Continued

Country	1939	1940	1941	1942	1943	1944
Africa:						
Algeria.....	† 85,000	(²)	(²)	(²)	(²)	(²)
Bechuanaland.....	813	1,207	949	1,267	1,221	1,
Belgian Congo.....	2,800,000	2,536,582	3,472,280	3,954,541	3,250,579	(²)
Gold Coast (exports).....	46,403	46,021	36,356	66,580	50,288	56,
Kenya Colony.....	† 12,000	13,626	15,643	15,602	16,354	(²)
Morocco, French.....	† 208,000	(²)	(²)	(²)	(²)	(²)
Nigeria.....	† 50,000	(²)	(²)	(²)	(²)	(²)
Portuguese East Africa.....	2,319	1,901	1,394	907	559	(²)
Rhodesia:						
Northern.....	80,137	312	45,697	40,000	(²)	(²)
Southern.....	173,556	186,080	170,364	163,776	119,322	103,
Sierra Leone.....	† 1,300	(²)	(²)	(²)	(²)	(²)
South-West Africa.....	558,290	381,850	(²)	(²)	(²)	(²)
Tanganyika.....	28,004	36,737	40,143	† 25,087	18,304	16,
Tunisia.....	54,367	41,056	55,974	(²)	(²)	(²)
Uganda.....	1,376	1,015	1,005	(²)	(²)	(²)
Union of South Africa.....	1,182,516	1,292,284	1,482,903	1,477,557	1,334,042	(²)
	† 5,284,000	† 5,907,000	† 6,018,000	† 6,436,000	† 6,074,000	(²)
Oceania:						
Australia:						
Commonwealth ³	14,950,905	14,077,000	512,000,000	9,507,632	8,593,311	(²)
New Guinea, Mandate of.....	† 175,015	199,084	† 125,000	46,284	(²)	(²)
Fiji.....	(²)	23,020	† 30,382	28,911	19,518	(²)
New Zealand.....	390,342	415,330	378,331	311,360	280,786	(²)
	† 15,534,000	† 14,714,000	† 12,534,000	† 9,894,000	† 8,929,000	(²)
World total⁴.....	265,769,000	275,387,000	261,566,000	247,744,000	217,041,000	186,200,00

¹ Preliminary world silver production table prepared, with revisions and adjustments, by R. B. Waldbauer and J. R. Keighley, Foreign Minerals Division, Bureau of Mines, in cooperation with the Office of the Director of the Mint.

² Philippine Islands excluded.

³ Imports into the United States. Scrap is included in this figure in many instances, most notably in the case of Cuba.

⁴ Data not available. Estimate included in total.

⁵ Approximate production.

⁶ Exports.

⁷ American Bureau of Metal Statistics (New York), Annual Issue.

⁸ Includes New South Wales, Northern Territory, Queensland, South Australia, Tasmania, Victoria and West Australia.

REVIEW BY COUNTRIES

CANADA

Canadian output of gold and silver in 1944 continued to drop from 1943—gold 22 percent and silver 21 percent; gold output totaled scarcely more than half that of the record year 1941. Production by sources remained in about the same ratio—83 percent from quartz lodes and placers and 17 percent from base metals. Output of gold and silver in 1944 was distributed among the various Provinces as follows:

Province:	Gold, fine ounces	Silver, fine ounces
Alberta.....	51	—
British Columbia.....	191,423	5,600,242
Manitoba.....	74,665	661,893
Northwest Territories.....	20,739	5,428
Nova Scotia.....	5,859	190
Ontario.....	1,704,457	2,986,479
Quebec.....	740,744	2,558,308
Saskatchewan.....	123,230	1,741,227
Yukon.....	24,306	32,735
Total.....	2,885,474	13,586,502

The labor situation continued bad. During the year employment in the gold lode mines dropped 6 percent from 16,400 at the beginning of the year to 15,400 at the close. It was stated that many mines had deteriorated to such an extent that after the war 2 years might be required to put them in condition for normal employment. Special acts were made by Ontario to keep cities and towns solvent, and *York Township* was placed under Provincial supervision.

The year witnessed a tremendous revival in prospecting. Hundreds of new companies and syndicates were formed to acquire holdings in all the way from northwestern Quebec to Yellowknife in the Northwest Territories, and trading in gold stocks on the Toronto exchange was very active. However, actual operations were limited by the Government to surface work and diamond drilling.

CENTRAL AMERICA

El Salvador.—Four mines produce most of the gold and silver from this country. All the metal is shipped to the United States for refining.

Nicaragua.—The gold-mining industry in Nicaragua is reported to have employed about 7,000 men in 1944 and to have produced 10 percent of the Government's tax revenue, or about \$500,000; it also provided 60 percent of the nation's export value.

SOUTH AMERICA

Brazil.—Gold output in Brazil in 1944 is reported to have been restricted mainly because of transportation difficulties and a short labor supply. The St. John d'El Rey Mining Co., by far the most important producer, is stated to have ore reserves of 9,453,000 tons averaging 11.8 grams of gold per ton, or about 3,600,000 ounces of gold, of which 65 percent is at the Morro Velho mine. The ore mined by the company in 1943 carried 12.2 grams of gold per ton. Considerable arsenic is also being recovered.

Chile.—Lodes continued to supply nearly 98 percent of Chile's gold, and sources were about equally divided between copper ores and gold ores.

Venezuela.—Gold mines in Venezuela in 1944 were adversely affected by curtailed development resulting from lack of equipment and restrictions on imports from the United States and Great Britain. Ore milled by New Gold fields of Venezuela, Ltd., was less than half the quantity milled in 1942. Also, the grade of ore has fallen so that the company is reported to be operating at a loss.

AFRICA

Union of South Africa.—Output of gold in the Union was maintained at a high rate in 1944, and production declined less than 4 percent from 1943. Profits and dividends, however, continued to drop, profits reaching a point 20 percent below 1940 and dividends 27 percent below.

The steady increase in working and milling costs and the decline in working profit and grade of ore have created a very unfavorable situation for a number of mines in the Union. Early in 1944 the Van Ryn Deep Gold Mining Co., the Witwatersrand Deep Gold Mining Co., and the Geldenhuis Deep Gold Mining Co. gave notice that they

would close in a short time. Other mines, among them the New Modderfontain and the Langlaagte Estate, were also approaching the limits of profitable operation. In reply to demands from some quarters that marginal mines should be afforded some measure of relief by the Government, the minister of mines asserted that it was bad policy to make other people pay to bolster up a mine or any other industry that could not stand on its own feet; therefore, if a mine could not pay its way it would have to close. But in spite of these unfavorable factors optimism prevailed for the future of the industry, provided that gold retains its purchasing power at a rate not less than existed in 1941 and that the demand for gold continues unlimited as it has through the ages.

Chief among the hopeful signs was the possibility of developing 4 or 5 average-size Rand mines, and possibly 10 to 15 ultimately, in the Orange Free State. The new area, as outlined by much drilling, is about 90 miles long north-south and 30 miles wide east-west; the town of Odendaalrust is near the center. All evidence at hand leaves little doubt that this district will witness outstanding development in the postwar period.

ASIA

India.—Output of gold in India in 1944 dropped nearly 26 percent from 1943, and production of gold ore declined from 651,849 tons in 1943 to 469,884 tons in 1944. One of the chief factors in the decline was the shortage of electric power that resulted when the Government power plant was severely damaged by lightning in May.

AUSTRALIA

Concern was expressed in Australia over the continued decline of gold production in the Commonwealth. The chief causes of the slump were manpower restrictions, high cost of stores and materials, low efficiency of the labor obtainable, and the high percentage of absenteeism. It was stated that the Government had removed and packed much equipment from the gold mines to be shipped to base-metal mines but that a considerable part of such material had not been used. Because of the removals many mines had been forced to close.

It was reported that Wiluna Gold Mines, Ltd., had failed to find profitable ore below the 2,000-foot level; as a consequence, the closing date of the mine might not be far in the future.

COPPER

By T. H. MILLER AND HELENA M. MEYER

SUMMARY OUTLINE

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SUMMARY

At the beginning of 1944 copper was one of several commodities, supplies of which appeared ample for all war and essential civilian requirements, but as the year ended requirements for the metal were greater than ever before and the possibility loomed that supplies would be deficient during 1945. In January 1944 copper was removed from the list of critical materials (having at one time vied with steel as the most critical metal), but by the end of the year it was again high on the list. For most of 1944 supplies were rising in relation to consumption by permitted uses, and the tendency of the Government in 1943 to make more copper available for uses where substitutes had proved inefficient or costly was continued. The improvement noted was despite the recession in mine, smelter, and refinery outputs below the peak rates that prevailed in 1943; it was due partly to the record imports of refined copper in 1944. During the year battlefield scrap began to arrive from abroad and to contribute to supply. Early in the third quarter of 1944 premature hopes for an early end of the European phase of the war led to fears in some quarters that surpluses rather than shortages would soon plague the market, and prospects for increased allocations of copper for civilian consumption appeared bright. The passage of the Surplus Property Act (described later), effective October 3, relieved anxiety regarding surpluses that were expected to exist at the end of the war. The revised military outlook in the final quarter, following reverses in the European war theater, caused a sharp step-up in the small arms and heavy artillery ammunition programs and in other programs involving large use of copper. The rising demand combined with the falling production rates, removed all ideas of immediate surpluses, threw the supply-requirements relationship out of balance, and left little hope for material increase in civilian consumption allowances in the near future. At the end of 1944 the Government military program called for larger quantities of copper than ever before. As a consequence, all of the chief Government purchase contracts at home and

abroad were continued beyond the end of the year, and new contracts were consummated with Northern Rhodesia and Canada.

Smaller outputs in 1944 at mines, smelters, and refineries in the United States, despite increased mine capacity and the ability of smelters and refineries to make larger contributions, were caused almost entirely by an inadequate labor supply. Thus, mine production amounted to 270,000 tons in the first quarter of 1944, 259,000 in the second, 228,000 in the third, and 213,000 in the fourth. In November and December the output averaged 22 percent below the monthly average of 90,000 tons for January to March, inclusive, even though copper mining received greater stimulation in 1944 than in earlier war years, in one respect at least, as is evidenced by the payment of bonuses on 25 percent of the total output in 1944 compared with 23 percent in 1943 and 11 in 1942. Bonus payments data are shown in detail under Prices.

Features of the foreign trade situation in 1944 included new peak imports of refined copper, continuation of the reduced rate since 1941 in exports of refined copper, and new high record exports of insulated wire and cable. The last-named class of exports exceeded all other copper classes in 1944, including refined copper, which had been dominant since before 1900.

Copper ceiling prices continued in effect throughout 1944 at the levels established in 1941.

Late in 1944 some liberated countries and Spain were trying to place orders in the United States for copper. France was reported to have been allotted 10,000 tons, of which 7,000 were to be refined copper and 3,000 tons fired rifle shells.

Salient statistics of the copper industry in the United States, 1940-44, in short tons

	1940	1941	1942	1943	1944
New copper produced—					
From domestic ores, as reported by—					
Mines	878,086	958,149	1,080,061	1,090,818	972,549
Ore produced:					
Copper ore	169,278,476	178,452,504	192,285,626	198,119,735	191,063,648
Average yield of copper, percent	1.20	1.15	1.09	1.04	1.06
Smelters	909,084	966,072	1,087,991	1,092,939	1,003,379
Percent of world total	(2)	(2)	(2)	(2)	(2)
Refineries	927,239	975,408	1,064,792	1,082,079	973,852
From foreign ores, matte, etc., refinery reports	386,317	419,901	349,769	297,184	247,335
Total new refined, domestic and foreign	1,313,556	1,395,309	1,414,561	1,379,263	1,221,187
Secondary copper recovered from old scrap only	333,890	412,699	427,122	427,521	456,710
Copper content of copper sulfate produced by refiners	5,643	6,984	8,076	7,667	8,269
Total production, new and old and domestic and foreign	1,653,089	1,814,992	1,849,759	1,814,451	1,686,166
Imports (unmanufactured) ¹	491,342	735,545	764,393	716,654	787,219
Refined ²	68,337	346,994	401,436	402,762	492,395
Exports of metallic copper ³	427,650	158,893	210,518	294,456	237,514
Refined (ingots, bars, rods, etc.)	377,108	114,753	131,732	177,341	69,002
Stocks at end of year	334,500	317,500	319,500	309,500	392,000
Refined copper	91,500	77,500	84,000	68,500	81,000
Blister and materials in solution	243,000	240,000	235,500	241,000	311,000
Withdrawals from total supply on domestic account:					
Total new copper	1,008,785	1,641,550	1,678,091	1,621,666	1,632,709
Total new and old copper	1,541,000	2,368,000	2,606,000	2,708,000	2,584,000
Price, average cents per pound	11.3	11.8	⁴ 11.8	⁴ 11.8	⁴ 11.8
World smelter production, new copper	(2)	(2)	(2)	(2)	(2)

¹ Includes old tailings.

² Figures not yet available.

³ Data include copper imported for immediate consumption plus material entering country under bond.

⁴ Total exports of copper, exclusive of ore, concentrates, composition metal, and unrefined copper. Exclusive also of "Other manufactures of copper," for which figures of quantity are not recorded.

⁵ Exclusive of bonus payments of the Metals Reserve Company.

A shortage in brass-mill capacity, particularly of copper-base alloy was pointed out at a meeting of the Electric Industrial Control Industry Advisory Committee in July. Capacity for alloy rod production at that time was 94 million pounds a month, but production averaged only 84 million because of the inadequate supply of labor. The War Production Board advocated the substitution of aluminum where possible and moved to have an aluminum rod mill converted to the production of copper-base alloy. By January 1945 the alloy-rod output reached a new record rate of 101 million pounds, but rod mill facilities were expected to be strained, nonetheless, to meet Army requirements. By the end of 1944 step-ups in the Army ammunition program, coupled with labor shortage, caused a critical situation to develop in regard to brass strip. The wire-mill situation was also described as extremely critical. In a maximum effort to meet the Army's expanded 1945 ammunition program the War Production Board announced in December that all participating brass mills and those copper-wire mills producing field and assault wire had been placed on the National Production Urgency List, that arrangements were being made for the production of brass strip in Canadian mills, that copper-clad steel would be used in the small arms ammunition program, and that the utilization of steel-mill facilities for producing ammunition brass strip was being considered. At a Brass Mill Industry Advisory Committee meeting in December, members pointed out that inadequate manpower was the main obstacle to an increase in over-all alloy-brass strip production to the proposed average of 334 million pounds per month for 1945, which rate represented an increase of 50 percent over operating schedules in December 1944. Requirements for refined copper by the brass and wire mills, foundry and non-C. M. P. consumers in 1944 were estimated by the Copper Division of the War Production Board early in 1945 to have been 1,679,900 short tons as compared with supplies of 1,803,400 tons. Estimates for 1945 were reported at the same time as 1,980,000 and 1,576,000 tons, respectively. Thus, a deficit was in prospect for 1945 despite the anticipated 10-percent increase in supplies. A deficient strip-supply situation in 1944 was expected to become more critical in 1945.

LABOR CONDITIONS

The labor shortages described in the 1943 report of this series continued and were accentuated in 1944 at mines, mills, smelters, refineries, and fabricating plants. In contrast to the action of the Army both in 1943 and 1942 in releasing men for service in copper and other mines, not only was such action lacking in 1944, but draft deferments for copper miners became more difficult to obtain. The declining production rate at the mines (previously mentioned) is attributed chiefly to this problem of labor supply. War Production Board chairman, J. A. Krug, indicated that manpower at copper mines declined from 31,000 to 22,000, or 29 percent, from late 1943 to late 1944. Labor shortages impeded capacity operations at fabricating plants also in 1944, and after the military program was increased in the late fall measures were taken to obtain all possible additional workers by recruitment from less essential industries, by publicizing the great need for workers, by recruitment in recreation centers, and by the importation of workers from Jamaica.

The labor problem did not stop with the foregoing. Late in the year the Army announced that it must have approximately twice as much small caliber ammunition in the first half of 1945 as was previously thought necessary. In this connection Chairman Krug announced that 108,600 workers would be needed in ammunition plants in various areas of production, compared with 49,900 already employed. He said that three core plants would require 3,500 additional workers and that, to supply the above plants, brass-rod mills throughout the country would need 10,000 to 15,000 additional workers.

WAR AGENCY REGULATIONS

There were no major revisions in restriction orders affecting copper and copper-base alloys in 1944, and most of the changes applied to small quantities and to products for which substitutes had proved unsatisfactory because they were inefficient or unduly costly. The Controlled Materials Plan, described in the report of this series for 1942, brought steel, copper, and aluminum into precise, measured supply-requirements balance. The principal copper-control orders are War Production Board M-9, which restricts the acceptance of delivery of specified types of copper and copper-base alloy materials (other than controlled materials) and M-9-c, which restricts and prohibits use in the manufacture of specified items, and the amendments to these orders. A tendency toward greater generosity in allocating copper for civilian consumption in the latter part of the year was reversed at the year-end after the military outlook had grown worse and the military program had expanded enormously.

SURPLUS PROPERTY ACT

The Surplus Property Act, effective October 3, provided that all Government-owned accumulations of certain strategic minerals and metals (including scrap), when determined to be surplus, should be added to the permanent Government stock pile authorized by the act of June 7, 1939. Anxiety regarding the dumping of postwar inventories was partly relieved by this action, which, in effect, freezes until January 1946 the entire Government surplus of copper and a number of other metals that may be on hand at the end of the war. Permanent stock-pile legislation was under consideration by the Seventy-ninth Congress.

FOREIGN ECONOMIC ADMINISTRATION PURCHASES

The Foreign Economic Administration was created by an Executive order issued September 25, 1943, and one main function of the new organization was the procurement of minerals from abroad. Alan M. Bateman, in an address on the Postwar Position of World Minerals in New York, February 19, 1945, said that only 20 percent of the foreign copper purchased by F. E. A. was at a cost in excess of 12 cents a pound. Dr. Bateman also stated that 80 percent of purchases is delivered at 11.75 cents a pound and 20 percent at above ceiling prices of the Office of Price Administration, making the current average price for all imported copper less than 12.5 cents a pound. At the time he talked the Government's foreign procurement, combined with private purchases, was at an annual rate of over 1,000,000

for copper. In discussing problems raised by wartime foreign procurement, he said:

Statements have been made publicly that vast sums were loaned to foreign countries for mineral developments. I should like to correct this. No loans as such were made by the Metals Reserve Company or the Foreign Economic Administration for foreign mineral development. In certain cases, however, credits against future delivery were made to permit development and plant expansion. In a few cases, the Defense Plant Corporation built new plants or plant expansion. Most of the foreign mineral financing or plant expansion was made by the producing companies. The hazards, uncertainties, and high cost of such contracts necessitated that certain risks be undertaken by the Government, and such contracts were made f. o. b. foreign ports.

POSSIBLE NEED FOR INTERNATIONAL COOPERATION

The future for copper from an international standpoint has been considered alarming in some quarters. Under the stimulus of gigantic war demand, world production had grown to roughly 3,000,000 short tons annually. Prewar (1928-37) rates averaged 1,700,000 tons. Thus an excess capacity of 1,300,000 tons appeared to exist unless postwar consumption rates were established at higher than prewar levels. Moreover, Chile, which made the greatest tonnage gain among exporting nations became divorced from accustomed European markets during the war and faced greater competition for them in the future. The United States began to take almost all of Chile's output in 1941. When the war is over the United States will be able to supply all of its consumption requirements provided the excise tax is continued, and particularly if consumption rates recede to prewar levels. Canada's increased production appears to be without an assured market, and production from Rhodesia and Belgian Congo appear to face reduced markets. Costs of production in Chile have risen during the war until they are no longer as favorable competitively as before. Production in Canada is largely byproduct, and this condition is a strong competitive factor. Some preference in filling British Empire needs may be accorded Rhodesia because it is a colonial producer and operates on a sterling base. Belgian Congo, which would compete for the same markets as the other large producers outside of the United States, has large, high-grade reserves and an undoubted advantage over some others in the matter of costs. Except for the United States, there are no present important copper-consuming centers outside of Europe, U. S. S. R., and Japan. Nationals of the United States are in the dual position of wanting the domestic market protected and of having interest in cooperative beneficial action in the international market because of their control of all large copper mines in Chile, Peru, and Mexico and of their large investments in Rhodesian mines. There was much speculation during the year, particularly in the latter part, as to possibilities for handling the delicate problems presented by the foregoing conditions because the adverse attitude of the United States Government toward cartels was well-known. Unless unexpectedly high rates of consumption prevail in the world after the war, a reduction in production appears inevitable. Whether such reduction results from competition or through cooperative action was a matter for conjecture at the end of 1944. The Metal Bulletin (London) of December 22 repeated a prediction that marketing problems facing primary copper producers as war consumption diminished would lead eventually to an attempt to arrange a control scheme under Government auspices.

RESERVES

Pehrson ¹ has presented the following analysis in regard to United States copper reserves:

Copper reserves as of 1944 have been estimated by Ralph S. Cannon (Geological Survey) and McHenry Mosier (Bureau of Mines) at 20,000,000 tons of recoverable metal under prevailing conditions. Since they include some reserves available only at premium prices they may be considered as a generous appraisal of commercial reserves under normal conditions. A quarter of the tonnage is classed as inferred. It is estimated that production could be maintained at the rate of 1,000,000 tons per year for nearly 10 years, following which would come a gradual decline to exhaustion. Submarginal resources have been estimated at 10,000,000 tons of copper contained in 1.25 billion tons of material.

INVESTIGATIONS OF THE GEOLOGICAL SURVEY AND THE BUREAU OF MINES

Geologic investigations of copper resources were actively continued by the Geological Survey throughout 1944. Copper deposits in Alaska and Mexico were studied, as well as in Arizona, California, Colorado, Idaho, Michigan, Montana, New Mexico, North Carolina, Texas, Virginia, and Wisconsin.

A number of domestic copper deposits were examined in 1944 at the request of war agencies, and several studies were conducted in conjunction with exploration projects of the Bureau of Mines. Rather comprehensive investigations of the Bagdad, Castle Dome, and San Manuel porphyry copper deposits in Arizona and at active mines on the Keweenaw Peninsula of Michigan and the foothill copper belt of California were continued throughout the year. Results of several completed studies were made available to the public in preliminary form. Preliminary geologic maps of the Orange County, Vt., copper district, and of the Reward area, Casa Grande district, Pinal County, Ariz., were released for public distribution. Preliminary reports on studies of the Orange County, Vt., copper district, and the Empire mine near Mackay, Custer County, Idaho, were placed in open files.

In southeastern Alaska the Geological Survey investigated the iron-copper deposits of the Mount Andrew area and the Tolstoi Mountain area on Kasaan Peninsula, the copper-bearing zinc deposits at Tracy Arm on the mainland, and the copper-bearing iron deposits of Jumbo Basin. The copper-bearing molybdenum deposits at Orange Hill in the Copper River region also were studied.

In Mexico the Geological Survey investigated copper deposits at La Dicha in Guerrero and at Oropeo in Michoacan during 1944 under the auspices of the United States Department of State.

The Bureau of Mines continued its copper-exploration projects in 1944, and war minerals reports on the following areas were issued for limited distribution.

- 158. Western Nevada Copper Co., Lyon County, Nev., January 1944.
- 159. Moffet-Johnston Property, Madison County, Mont., February 1944.
- 160. Ore Knob Mine, Ashe County, N. C. (Supplement to No. 61), February 1944.
- 190. Majuba Hill Mine, Pershing County, Nev., May 1944.
- 217. Toncræ-Howard Properties, Floyd County, Va., August 1944.
- 228. Eureka-Union (Vermont Copper Co.), Orange County, Vt., August 1944.
- 236. Green Mountain Copper Mine, Sanders County, Mont., September 1944.
- 246. Boston Consolidated Mine, Salt Lake County, Utah (Supplement to No. 127), October 1944.

¹ Pehrson, Elmer W., *The Mineral Position of the United States and the Outlook for the Future: Min. and Met.*, vol. 26, No. 460, April 1945, pp. 204-214.

- 257. Ely Mine, Orange County, Vt. (Supplement to No. 6), October 1944.
- 258. Copper Nugget Placer, Jefferson County, Mont., November 1944.
- 259. Empire Mine, Mackay, Custer County, Idaho (Supplement to No. 68), November 1944.
- 260. Old Reliable Mine, Pinal County, Ariz., November 1944.
- 261. Virginia District, Halifax County, Va., Person and Granville Counties, N. C., November 1944.
- 262. Atwood Group, Lordsburg District, Hidalgo County, N. Mex. (Supplement to No. 25), November 1944.
- 263. Copper King Mine, Taos County, N. Mex., November 1944.
- 264. Rambler Mine, Albany County, Wyo. (Supplement to No. 17), November 1944.
- 265. Colorado Copper Co. Deposits, Montrose County, Colo., November 1944.
- 266. Suggested Mining Methods at Christmas Mine, Gila County, Ariz., December 1944.

POSTWAR OUTLOOK

Opinion is virtually unanimous that the war will be followed by a period of great industrial activity in the United States and that a similar condition will develop abroad where finances are available or credits obtainable. In the United States this activity will characterize the period when pent-up demands for automobiles, refrigerators, washing machines, and other items are being filled, and abroad it will come when reconstruction and rehabilitation are in progress. During this era copper, always a good index of industrial activity, will be in large demand. The possibility that, after the war, substitute materials will replace copper in large or small degree was discussed in the report of this series for 1943, and the conclusion was reached that the relationship between postwar levels of consumption of copper and general industrial activity will be similar to the prewar relationship.

R. L. Wilcox,² chief, Metals Branch Conservation Division, War Production Board, commented that some metals in relatively ample supply are in a very advantageous position to develop and possibly to enter postwar markets which would normally employ another metal the supply of which had been inadequate. In connection with the question as to whether metals in insufficient supply would regain their normal uses, he said:

This is a difficult question to answer—undoubtedly some normal uses of certain metals will never be regained—but based on almost 3 years experience in the War Production Board on problems of substitution of one metal for another, it would appear that contrary to popular belief the normal or prewar use position or standing of our common metals will continue after the war with little real change.

Ingalls³ discussed the possible level of consumption in the United States after the war as follows:

The total of these estimates, omitting shipbuilding, is 1,265,000 tons, which I think may be an understatement rather than an overstatement. Estimating that two thirds of this will be supplied with new copper, which is a little higher than the ratio in 1937, the indicated tonnage is 843,000 or, say, 850,000. The total of 1,265,000 for new copper plus old compares with 1,129,000 in 1937 which was our largest prewar year since 1930. The total of 1,129,000 (which remains after deduction of manufactures for export) figures at 17.5 pounds per caput. A consumption of 1,265,000 tons would be 18 pounds per caput of the expected population of 140 million at the middle of 1945. A gain of that order would not be in any way out of harmony with an idea of the increases under the heads of building, motor vehicles, communications, and otherwise that are required to supply deficiencies.

¹ Wilcox, R. L., *The Battle of Tempo R*: Min. Cong. Jour., vol. 30, No. 12, December 1944, p. 42.

² Ingalls, W. R., *What for Copper After the War?*: Min. and Met., vol. 25, No. 453, September 1944, pp. 47-49.

Regarding substitution he concluded:

In general copper and the several copper alloys are valued for the uses to which they are especially adapted and for that reason have resisted substitutions for cheaper substances.

Thus, the two writers quoted agree that substitution of other materials for copper will not be serious after the war; in fact, Ingalls thinks that postwar consumption will exceed that for 1937, when consumption was higher than at any time since 1930.

The foregoing discussion fortifies the opinions concerning the postwar outlook in the chapter on Copper of Minerals Yearbook, 1943, but another year of postponed civilian needs has been added. The 1943 report, however, stated that two political factors would have a sharp bearing on the postwar demand for newly mined copper, that is, the Government attitude toward stock-piling refined metal, intermediate war materials, scrap returned from battlefields, and scrap from obsolete equipment of all kinds, and the Government attitude toward permitting entry into the country of foreign crude, refined, and fabricated copper. The first of the two questions was settled only for 1 year by the passage of the Surplus Property Act, already described. The answer to the second question is tied in with continuation of the excise tax on copper after the war and with Government action in regard to the Reciprocal Trade Agreements Act through which the copper tax may be reduced 50 percent; that is, the present level of 4 cents a pound could be cut to 2 cents.

The restraining influence of the Office of Price Administration on price increases in general has not prevented them altogether; as a consequence, costs of producing copper have increased during the war. Moreover, because of emphasis on high production rates a considerable quantity of the more cheaply mined copper has been removed from the ground. Labor shortage, too, has impeded development, and this condition points to higher costs in the future. The foregoing factors indicate that higher copper prices may be needed in the postwar era to bring out enough copper for the anticipated domestic demand.

From an international standpoint a perplexing problem results from the fact that world production capacities are considerably above even the most optimistic ideas concerning postwar world-consumption levels. This problem was discussed under Possible Need for International Cooperation.

DOMESTIC PRODUCTION

Statistics on copper production may be compiled upon a mine, smelter, or refinery basis. Mine data are most accurate for showing the geographic distribution of production; smelter figures are better for showing the actual recovery of metal and fairly accurate for showing the source of production; and refinery statistics give precise information regarding metal recovery but indicate only in a general way the source of crude materials treated. The chapter on Copper in Mineral Resources of the United States, 1930, part 1, discusses the differences among the three sets of figures.

For detailed information by States, districts, and mines, the reader is referred to the various State chapters on gold, silver, copper, lead, and zinc.

Copper produced from domestic ores, as reported by mines, smelters, and refineries, 1940-44, in short tons

Year	Mine	Smelter	Refinery
1940	878,086	909,084	927,239
1941	958,149	966,072	975,408
1942	1,080,061	1,087,991	1,064,792
1943	1,090,818	1,092,939	1,082,079
1944	972,549	1,003,379	973,852

PRIMARY COPPER

Smelter production.—The recovery of copper by smelters in the United States from ores of domestic origin totaled 1,003,379 short tons in 1944, a decline of 8 percent from the total of 1,092,939 tons for 1943. Domestic smelter output constituted 51 percent of the world production during 1925-29 but dropped sharply in the succeeding years until 1934, when it was only 17 percent. From 1936 to 1940 it fluctuated between 25 and 32 percent, and in 1942-44 it is believed to have been close to 35 percent.

The figures for smelter production are based upon confidential returns from all smelters handling copper-bearing materials produced in the United States. For Michigan the sum of furnace-refined copper and copper cast into anodes for electrolytic refining is included. The figures for blister represent the fine-copper content. Some casting and electrolytic copper produced direct from ore or matte is included in the smelter production. Metallic and cement copper recovered by leaching is included in smelter production.

The precise quantity, in pounds, of copper produced by smelters in the United States and its value are shown by years for 1845-1930 in the Copper chapter of Mineral Resources of the United States, 1930, part 1.

Copper produced in the United States from domestic ores, 1940-44, by States

(Smelter output, in short tons fine)

State	1940	1941	1942	1943	1944
Alaska	64	95	33	31	4
Arizona	287,267	328,550	388,394	397,434	368,549
California	8,546	4,015	1,019	8,522	13,200
Colorado	13,186	6,483	1,249	1,134	1,257
Idaho	13				
Montana	3,690	3,551	3,889	2,330	1,440
Michigan	45,743	46,752	47,470	45,498	42,334
Minnesota	819	773	2,658	1,736	3,472
Nebraska	129,071	128,712	140,465	138,295	117,856
Nevada	78,621	80,518	83,434	71,553	61,109
New Mexico	70,484	73,848	79,598	78,804	70,267
North Carolina	(1)	(1)	(1)	(1)	(1)
Pennsylvania	101	84	113	9	11
South Carolina	(1)	(1)	(1)	(1)	(1)
South Dakota			1	1	
Tennessee	6			1	1
Utah	(1)	(1)	(1)	(1)	(1)
Virginia	33	7	104	84	127
West Virginia	248,732	270,647	317,717	325,961	301,676
Wisconsin				100	1,854
Wyoming				51	260
Not reported	10,511	8,667	8,525	7,407	6,567
Unallocated	2	4	1	1	
Total	14,195	13,366	13,321	13,987	13,395
	909,084	966,072	1,087,991	1,092,939	1,003,379

¹Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.

*Copper produced (smelter output) in the United States, 1940-44, and total, 1845-1944*¹

[Values rounded]

Year	Short tons	Value
1940.....	909,084	\$205,453,000
1941.....	966,072	227,993,000
1942.....	1,087,991	1 256,766,000
1943.....	1,092,939	1 257,934,000
1944.....	1,003,379	1 236,797,000
Total, 1845-1944.....	31,648,859	9,231,510,000

¹ Excludes bonus payments of Metals Reserve Company.

Mine production.—The figures for mine production are based upon reports supplied to the Bureau of Mines by all domestic mines that produce copper. Details of the method of collecting the statistics and reasons for the discrepancy between mine-, smelter-, and refinery-production figures are given in the Copper chapter of Mineral Resources of the United States, 1930, part 1.

Mine production is more accurate than either refinery or smelter production for showing the distribution of domestic output by States and districts. It also indicates the production by calendar years more exactly, because additional time is required for smelting and refining. Mine production in 1944 was 972,549 tons—a decrease of 11 percent from that in 1943 but 10 percent above the average for 1925-29.

Production by States and districts.—The following tables show mine and smelter production, by States, for 1943 and 1944 and mine output, by districts, for 1940-44. Arizona, with 37 percent, produced the largest share of the total in 1944, as for many previous years. Utah, which has been gaining during the war period, was close behind the premier State with a 30-percent share. Montana, which ranked third, produced less than one-third of Arizona's total and contributed 12 percent of the total for the United States. Together the three States contributed nearly 79 percent of the country's total and with the next three States in rank (New Mexico, Nevada, and Michigan), 96 percent. Production in all of the important copper-producing States decreased in 1944, and the declining movement was characteristic of operations in most States. Noteworthy exceptions to the general trend were California, Missouri, and Vermont, where Government aid in opening or expanding production brought positive results. Comparison of present production with that of the past century focuses attention on Utah's sharp rise, the leveling off of production in Arizona, and the large drops in Michigan and Montana. In 1944 New Mexico produced close to double the percentage for 1845-1944, and Nevada likewise showed a gain though in smaller proportion.

The Bingham district, Utah, ranked first among the copper-producing districts of the world in 1944; this district had held the preeminent position among United States copper districts since 1936. Production in the Bingham district was 2.4 times as large as in the Butte district, Mont., normally the second ranking area. In total output from the beginning of operations Butte easily outranks all other districts, having produced well over 6 million tons at the end of 1944. The Globe-Miami district had seemed fairly well established as the third ranking district a few years ago, but sharp gains in production at the Morenci mine caused the Morenci district to rise to third position in 1944.

Copper produced in the United States according to smelter and mine returns, by States, 1943-44, and 1845-1944, in short tons

State	1943		1944			1845-1944 smelter output	
	Smelter returns	Mine returns	Smelter returns		Mine returns	Total quantity	Percent of total
			Percent of total	Quantity			
Alaska	31	27	(1)	4	2	676,851	2.14
Arizona	397,434	403,181	36.73	368,549	358,303	10,568,865	33.39
California	8,522	8,762	1.32	13,200	12,721	597,209	1.89
Colorado	1,134	1,028	.13	1,257	1,048	275,155	.87
Idaho	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Montana	2,330	2,324	.14	1,440	1,688	99,150	.31
Nevada	45,498	46,764	4.22	42,334	42,421	4,772,687	15.08
New Mexico	1,736	1,340	.35	3,472	3,302	(2)	(2)
New York	138,295	134,525	11.75	117,856	118,190	6,479,373	20.47
North Carolina	71,553	71,068	6.09	61,109	61,232	1,669,573	5.28
North Dakota	78,804	76,163	7.00	70,267	69,730	1,238,972	3.91
Ohio	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Ore	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Pennsylvania	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Rhode Island	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Tennessee	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Utah	84	81	.01	127	115	(2)	(2)
Washington	325,961	323,989	30.07	301,676	282,575	4,613,092	14.58
West Virginia	100	290	.18	1,854	1,898	(2)	(2)
Wisconsin	51	100	.03	260	291	(2)	(2)
Wyoming	7,407	7,315	.65	6,567	6,169	70,775	.22
Unallocated	1	1	(2)	(2)	(2)	15,871	.05
Total	13,987	13,855	1.33	13,395	12,860	300,110	.95
Total	1,092,939	1,090,818	100.00	1,003,379	972,549	31,648,859	100.00

(1) Less than 0.01 percent.

(2) Included under "Undistributed"; figures not separately recorded.

(3) Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.

(4) Confidential.

(5) Estimate production through 1928. Figures for 1929-44 confidential and included under "Undis-

tributed Tennessee for 1929-44.

How production of copper in the principal districts ¹ of the United States, 1940-44, in terms of recovered copper, in short tons

District or region	State	1940	1941	1942	1943	1944
400 Mountain (Bingham)	Utah	228,505	264,705	304,687	322,248	281,100
400 Valley Butte	Montana	125,442	127,431	140,349	133,569	117,363
400 Mountain (Morenci)	Arizona	13,503	13,879	60,356	84,347	106,926
400 Valley	do	70,406	82,419	94,265	100,513	95,305
400 Valley (Santa Rita)	New Mexico	64,991	67,727	72,724	70,628	65,520
400 Valley	Nevada	63,840	67,171	75,063	64,090	54,651
400 Valley	Arizona	51,596	65,880	66,647	70,069	46,250
400 Valley	Michigan	45,198	46,440	45,679	46,764	42,421
400 Valley	Arizona	55,254	56,592	53,278	50,786	32,683
400 Valley (mostly Verde River district)	do	38,201	43,701	44,941	38,386	32,273
400 Valley (Ray)	do	31,729	42,400	50,362	37,434	27,452
400 Valley	do	18,447	19,119	20,701	18,820	12,722
400 Valley	California	(2)	(2)	2	5,067	7,891
400 Valley	Washington	9,288	8,365	7,955	7,219	6,119
400 Valley	New Mexico	3,278	3,734	3,358	2,496	2,359
400 Valley	California	(2)	1	264	1,930	2,122
400 Valley	do	(2)	59	(2)	670	1,292
400 Valley	Idaho	2,680	2,979	2,993	1,987	1,289
400 Valley	New Mexico	(2)	1,144	3,656	2,094	1,261
400 Valley	Utah	1,295	1,042	853	841	533
400 Valley	Colorado	1,209	705	539	554	512
400 Valley (Battle Mountain)	Utah	1,095	204	202	116	64
400 Valley	Colorado	10,552	5,609	323	115	55
400 Valley	California	5,293	3,644	(2)	7	(2)
400 Valley	New Mexico	1,394	719	(2)	(2)	(2)
400 Valley	Nevada	13,542	10,756	7,074	5,133	(2)
400 Valley	North Carolina	(2)	(2)	(2)	(2)	(2)
400 Valley (Newall mine)	Pennsylvania	(2)	(2)	(2)	(2)	(2)
400 Valley	Tennessee	(2)	(2)	(2)	(2)	(2)

¹ Districts producing 1,000 short tons or more in any year of the period 1940-44.

(1) Confidential.

(2) Bureau of Mines not at liberty to publish figures.

(3) Included in order of output.

Quantity and estimated recoverable content of copper-bearing ores.—The following tables list the quantity and estimated recoverable copper content of the ore produced by mines in the United States in 1943; complete details for 1944 are not yet available. Of the total copper produced from copper ores in the United States during 1943, 88 percent was obtained from ores concentrated before smelting, 8 percent from direct smelting ores, and 4 percent from ore treated by straight leaching. The percentages for 1943 compared with 87 percent obtained from concentrated ore, 9 percent from direct smelting ores, and 4 percent by straight leaching in 1942.

Close agreement between the output as reported by smelters and the recoverable quantity as reported by mines indicates that the estimated recoverable tenor is close to the actual recovery. Classification of some of the complex western ores is difficult and more or less arbitrary. "Copper ores" include not only those that contain 2.5 percent or more copper but also those that contain less than this percentage if they are valuable chiefly for copper. Mines report considerable copper from ores mined primarily for other metals. These include siliceous gold and silver ores, lead and zinc ores, and pyritic ores.

Copper ore, old tailings, etc., sold or treated in the United States in 1943, with copper, gold, and silver content in terms of recovered metals

State	Ore, old tailings, etc., sold or treated (short tons)	Copper produced		Gold produced (fine ounces)	Silver produced (fine ounces)	Value of gold and silver per ton of ore
		Pounds	Percent			
Alaska	8	12,100	75.63	19	52	\$87.75
Arizona	36,022,080	¹ 764,424,987	1.06	133,746	4,367,003	.22
California	265,526	¹ 15,965,600	3.01	2,971	47,214	.52
Colorado	3,008	184,853	3.07	76	12,107	3.75
Idaho	329	67,025	10.19	24	8,515	20.96
Michigan	4,403,594	93,528,000	1.06		48,479	.01
Montana	5,068,865	¹ 261,415,679	2.58	14,355	6,012,808	.94
Nevada	7,721,562	¹ 132,578,400	.86	72,449	365,112	.36
New Mexico	7,571,937	¹ 122,988,529	.81	2,058	100,503	.02
Oregon	34	6,300	9.26	4	3	4.18
Texas	339	19,761	2.91		98	.21
Utah	35,999,656	¹ 611,950,873	.85	310,242	2,917,239	.36
Washington	2,339	123,700	2.64	11	1,119	.50
Eastern States	1,060,458	² 28,289,000		451	61,948	
	98,119,735	² 2,031,554,807	1.04	536,406	13,942,200	.29

¹ Excludes copper recovered from precipitates as follows: Arizona, 37,361,514 pounds; California, 65,000; Montana, 4,369,199; Nevada, 8,865,300; New Mexico, 27,744,537; Utah, 27,987,429 pounds.

² Copper from magnetite-pyrite-chalcopyrite ore from Pennsylvania included with that from copper ore.

Copper ore, old tailings, etc., concentrated in the United States in 1943, with content in terms of recovered copper

State	Ore, old tailings, etc., concentrated (short tons)	Concentrates produced (short tons)	Copper produced (pounds)	Copper from ore, etc. (percent)
Arizona	¹ 30,595,456	1,334,586	² 549,386,668	0.90
California	261,321	40,286	15,209,600	2.91
Colorado	921	206	46,816	2.54
Michigan	4,403,594	71,571	93,528,000	1.06
Montana	4,988,691	531,121	256,056,839	2.57
Nevada	7,623,578	251,777	124,176,000	.81
New Mexico	7,477,738	223,763	120,160,530	.80
Utah	35,998,280	991,085	611,806,745	.85
Washington	2,297	182	104,281	2.27
Eastern States	894,746	³ 73,957	⁴ 24,516,000	
	92,246,622	³ 3,518,534	⁴ 1,794,991,479	.97

¹ In addition, 3,721,926 tons were treated by straight leaching.

² In addition, 80,054,827 pounds of copper were recovered by straight leaching.

³ Includes concentrates from magnetite-pyrite-chalcopyrite ore from Pennsylvania.

⁴ Includes copper from magnetite-pyrite-chalcopyrite ore from Pennsylvania.

Copper ore, old tailings, etc., smelted in the United States in 1943, with content in terms of recovered copper, and copper produced from all sources, in terms of recovered copper

State	Ore, old tailings, etc., smelted			Copper from all sources, including old slags, smelter cleanings, and precipitates (pounds)
	Short tons	Copper produced (pounds)	Percent of copper	
Ala.	8	12,100	75.63	54,000
Cal.	1,704,698	134,983,492	3.96	¹ 806,362,000
Col.	4,205	756,000	8.99	17,524,000
Ill.	2,087	138,037	3.31	¹ 2,056,000
Ind.	329	67,025	10.19	¹ 4,648,000
Iowa				93,528,000
Mich.				2,680,000
Mont.	80,174	5,358,840	3.34	¹ 269,050,000
Nev.	97,984	8,402,400	4.29	¹ 142,136,000
N. Mexico	94,199	2,827,999	1.50	¹ 152,326,000
N. Y.	34	6,300	9.26	12,000
Ohio	339	19,761	2.91	162,000
Pa.	1,376	144,128	5.24	¹ 647,978,000
Utah	42	19,419	23.12	¹ 14,630,000
W. Va.	165,712	3,773,000	1.14	28,490,000
U. S. States	2,151,187	156,508,501	3.64	2,181,636,000

¹ Recoverable copper was recovered from precipitates.

² Most of the copper was recovered from ores classed as dry and siliceous and zinc-lead ores.

³ Recoverable copper was recovered from precipitates and from ores classed as dry and siliceous and zinc-

⁴ Most of the copper recovered was from ores classed as zinc-copper ore.

Copper ores produced in the United States, 1939-43, and average yield in copper, gold, and silver

Year	Smelting ores ¹		Concentrating ores ¹		Total				
	Short tons	Yield in copper (per cent)	Short tons	Yield in copper (per cent)	Short tons ¹	Yield in copper (per cent)	Yield per ton in gold (ounce)	Yield per ton in silver (ounce)	Value per ton in gold and silver
1939	2,396,155	4.61	50,710,026	1.09	55,239,098	1.25	0.0085	0.333	\$0.52
1940	2,179,060	4.33	63,900,512	1.10	69,278,476	1.20	.0078	.300	.48
1941	2,135,138	4.29	72,531,712	1.06	78,452,504	1.15	.0071	.239	.42
1942	2,221,191	4.00	85,865,167	1.02	92,285,626	1.09	.0063	.162	.34
1943	2,151,187	3.64	92,246,622	.97	98,119,735	1.04	.0055	.142	.29

¹ Includes old tailings, etc.

Refinery production.—The refinery output of copper in the United States in 1944 was made by 11 plants; 7 of these employed the electrolytic method only, 2 the furnace process on Lake Superior copper, 1 the furnace process on western ores, and 1 both the electrolytic and the furnace methods.

Five large electrolytic refineries are on the Atlantic seaboard, three Lake refineries on the Great Lakes, and three electrolytic refineries west of the Great Lakes—one at Great Falls, Mont.; one at Tacoma, Wash.; and one at El Paso, Tex. In 1942 fire-refined copper was produced for the first time at the Hurley, N. Mex., plant of the Kennecott Copper Corp., and virtually all of the plant output was treated by this method in 1944. The El Paso plant of the Phelps Dodge Refining Corp. produced furnace refined copper in addition to the usual electrolytic grade. Of the plants specified above, the Lake refinery of the Quincy Mining Co. has been idle since 1933.

In addition to the foregoing plants, that at Inspiration, Ariz., is equipped to make electrolytically refined copper direct from the liquor obtained from leaching; this copper is shipped as cathodes to other refineries, where it is melted and cast into merchant shapes.

The 13 plants indicated constitute what commonly are termed "regular refineries." Of these plants, 8 employ the electrolytic process, 4 the furnace process, and 1 both methods. The electrolytic plants have a rated capacity of 1,595,000 tons of refined copper a year. As they produced 1,160,000 tons in 1944, this part of the industry was operated at 73 percent of capacity.

The following tables show the production of refined copper at regular refining plants, classified according to source, grade, and form in which cast.

Primary and secondary copper produced by regular refining plants in the United States and imported, 1940-44, in short tons

	1940	1941	1942	1943	1944
Primary:					
Domestic: ¹					
Electrolytic ²	883,610	929,711	963,177	938,727	837,089
Lake ³	43,629	45,697	46,523	44,867	41,597
Casting.....			55,092	98,485	95,166
	927,239	975,408	1,064,792	1,082,079	973,852
Foreign: ¹					
Electrolytic.....	386,317	419,901	843,834	297,184	247,335
Casting and best select.....			5,935		
Refinery production, new copper.....	1,313,556	1,395,309	1,414,561	1,379,263	1,221,187
Imports, refined copper ³	68,337	346,994	401,436	402,762	492,395
Total new refined copper made available.....	1,381,893	1,742,303	1,815,997	1,782,025	1,713,582
Secondary:					
Electrolytic ⁴	117,669	95,437	83,079	114,259	78,407
Casting.....		4,238	2,064	8,205	7,999
	117,669	99,675	85,143	122,464	86,396
Grand total	1,499,562	1,841,978	1,901,140	1,904,489	1,799,978

¹ The separation of refined copper into metal of domestic and foreign origin is only approximate, as accurate separation at this stage of manufacture is not possible.

² Some copper from Michigan is electrolytically refined at eastern refineries and is included as electrolytic copper.

³ Data include copper imported for immediate consumption plus material entering country under bond.

⁴ Includes some secondary Lake copper.

Copper cast in forms in the United States, 1943-44

Form	1943		1944	
	Short tons	Percent	Short tons	Percent
Wire bars.....	473,500	31.53	493,000	37.2
Cathodes.....	503,000	33.50	358,000	27.5
Ingot.....	265,000	17.65	229,000	17.5
Cakes.....	145,500	9.69	104,000	7.9
Other forms.....	114,500	7.63	124,000	9.5
	1,501,500	100.00	1,308,000	100.0

In addition to the regular refineries, numerous plants throughout the country operate on scrap exclusively, producing metallic copper and a great variety of alloys. The output of these plants is not included in the statements of refined-copper production in the preceding tables but is included in the following statement on secondary-copper production.

Copper sulfate.—The production of hydrous copper sulfate or blue vitriol by copper refineries in the United States was 33,100 short tons containing a copper content of 8,269 tons in 1944 compared with 30,700 tons containing 7,667 tons in 1943. The output of copper sulfate by refineries other than the regular primary refineries totaled 69,500 tons with a reported content of 17,377 tons in 1944 compared with 58,400 tons containing 14,597 tons of copper in 1943. Producers held 14,300 tons of copper sulfate at the beginning of 1944, total production was 102,600 tons, and shipments amounted to 97,900 tons. Some small purchases were made during the year, and producers used an amount equivalent to 4 percent of shipments. Inventories at the year end were 10,300 tons.

The Requirements Committee of the Chemicals Bureau (War Production Board) approved the program shown later for distribution of copper sulfate in the 1944-45 agricultural year. The period covered was the 4 quarters beginning October 1, 1944, for everything except copper sulfate destined to areas liberated from Nazi domination and to the first 3 quarters only for the last-named item. The program applied to the following quantities:

	Pounds
U. S. Military Government (for United Nations Relief and Rehabilitation Administration in liberated areas).....	18, 337, 000
Food Administration.....	100, 000, 000
Economic Administration (banana, mining, and other uses in countries that come under this organization).....	60, 000, 000
Other.....	3, 000, 000
Total purposes.....	75, 000, 000

The foregoing distribution was contingent on the ability of the industry to accelerate production to meet the large requirements and on the allocation of adequate raw materials by the Copper Division of the War Production Board.

SECONDARY COPPER

Secondary copper includes material recovered from remelting old copper and copper scrap and from the treatment of copper alloys or alloys treated without separation of the copper. The following table summarizes the production of secondary copper during 1940-44. Further details appear in the chapter on Secondary Metals—Non-ferrous.

Secondary copper produced in the United States, 1940-44, in short tons

	1940	1941	1942	1943	1944
Copper recovered as unalloyed copper.....	170, 839	135, 869	114, 647	137, 883	102, 135
Copper recovered in alloys.....	1 361, 207	1 590, 527	1 813, 108	1 948, 164	1 848, 807
Total secondary copper.....	532, 046	726, 396	927, 755	1, 086, 047	950, 942
From new scrap.....	198, 156	313, 697	500, 633	658, 526	494, 232
From old scrap.....	333, 890	412, 699	427, 122	427, 521	456, 710
Percentage of domestic mine output.....	61	76	86	100	98

Other copper in chemicals, as follows: 1940, 9,431 tons; 1941, 9,804; 1942, 17,455; 1943, 13,019; 1944, 13,357

CONSUMPTION

The following table gives figures on apparent consumption of copper in the United States. In estimating apparent consumption it has been assumed that copper used in the manufacture of primary fabrications of copper is consumed. It is likely that statistics compiled upon a different basis (for example, by taking consumption as including or excluding copper made into automobiles, electrical equipment, ships, and other items) would show very different results. Much copper leaves the country as primary fabrications and considerably more in manufactured products containing copper. During the war large quantities of copper exported for military use were not accounted for in the foreign trade statistics. Likewise scrap or other materials imported on returning transport vessels were not listed in import figures. Actual consumption data may be compiled at many points in the industrial process. The method of calculating the quantity of copper available for consumption is shown in the following table. It should be noted that exports and stocks include some refined secondary copper that cannot be determined separately and also that actual consumption of new copper would differ from the figures shown in the table by the changes in the consumers' stocks.

New refined copper withdrawn from total year's supply on domestic account, 1940-44, in short tons

	1940	1941	1942	1943	1944
Total supply of new copper.....	1,381,893	1,742,303	1,815,997	1,782,025	1,713,591
Stock at beginning of year.....	95,500	91,500	77,500	84,000	68,500
Total available supply.....	1,477,393	1,833,803	1,893,497	1,866,025	1,782,091
Copper exported ¹	377,108	114,753	² 131,406	² 175,859	² 68,371
Stock at end of year.....	91,500	77,500	84,000	68,500	81,000
	468,608	192,253	215,406	244,359	149,371
Withdrawn on domestic account.....	1,008,785	1,641,550	1,678,091	1,621,666	1,632,720

¹ Includes refined copper in ingots, bars, rods, or other forms.

Excludes refined copper in rods.

STOCKS

The following table gives domestic stocks of copper as reported by primary smelting and refining plants. Stocks of blister and anode copper in transit from smelters to refineries are included under blister copper.

Stocks of copper at primary smelting and refining plants in the United States at end of year, 1940-44, in short tons

Year	Refined copper	Blister and materials in process of refining ¹	Year	Refined copper	Blister and materials in process of refining ¹
1940.....	91,500	243,000	1943.....	68,500	241,000
1941.....	77,500	240,000	1944.....	81,000	311,000
1942.....	84,000	235,500			

¹ Includes copper in transit from smelters in the United States to refineries therein.

inventories of copper available for war and essential civilian requirements increased in 1944, although stocks in all hands did not. Refined metal held by producers rose 18 percent, and blister and anodes in process of refining increased 27 percent. Stocks of refined copper in the hands of the Metals Reserve Company advanced sharply during the year. Totals for 1944 may not be stated as yet. At the end of 1943, 166,400 tons of electrolytic copper and 57,681 tons of fire-refined metal were on hand. Metals Reserve Company inventories are upon an ownership basis and, therefore, duplicate in part stocks reported by the refineries, which are on a plant basis. The precise amount of the duplication is not known, but it is believed to have approximated 14 percent of the Metals Reserve total at the end of 1944. Although fabricators' stocks declined both in 1943 and 1944 the general condition of these concerns improved materially during the year period. Stocks of refined copper, of material in process, and of primary fabricated shapes decreased from 414,668 tons at the end of 1943 to 334,017 tons at the end of 1944, or 19 percent. Meanwhile unfilled orders declined from 613,005 to 285,654 tons, respectively, or 53 percent, and the excess of stocks over orders booked, though still a considerable quantity, declined from -403,403 to -187,259 tons. At their all-time peak, unfilled fabricators' sales to customers totaled 689,177 tons in June 30, 1942. Thus, unfilled sales at the end of 1944 amounted to more than one-fourth of the peak tonnage for June 1942.

Stocks of copper in fabricators' hands at end of year, 1940-44, in short tons

	Stocks of refined copper	Unfilled purchases of refined copper from producers	Working stocks	Unfilled sales to customers	Excess stocks over orders booked
1940	1,713,900				
1941	1,782,000				
1942	1,782,000				
1943	414,668	326,269	240,740	414,892	10,013
1944	334,017	241,335	291,515	547,468	-304,675
		135,481	340,547	613,005	-403,403
		90,807	299,796	465,258	-320,299
		53,538	289,160	285,654	-187,259

Includes process metal and primary fabricated shapes. Also includes small quantities of refined metal at refineries for fabricators' account.

Figures compiled by the Copper Institute show that domestic sales of refined duty-free copper increased from 52,121 tons at the end of 1943 to 66,780 tons at the end of 1944. Inventory data of the Copper Institute and the Bureau of Mines are on different bases and, as a result, never agree. Under usual conditions the differences are in part to the somewhat different coverage and in part to an arbitrary but permissible method used by the Copper Institute in designating the copper as domestic or foreign metal. Owing to the fact that copper entering the United States since the end of 1941, as much as that imported in 1941, has been for the account of the Metals Reserve Company, stock data of the Copper Institute and the Bureau of Mines have been in closer agreement than during the period preceding the start of Metals Reserve Company purchases.

PRICES

Reports to the Bureau of Mines from copper-selling agencies indicate that 1,060,000 short tons of copper were delivered to domestic and foreign purchasers (excluding deliveries of foreign copper to the Metals Reserve Company) in 1944 at an average price (f. o. b. refinery)

of 11.8 cents a pound, unchanged from 1943, 1942, and 1941. The averages for 1942-44 exclude bonuses paid for overquota outputs individual mines, which were first applicable to February (194 tonnages). Complete details covering bonus payments since they began were released recently in a study made by the Office of Price Administration. The following table was compiled from the report.

Salient statistics covering bonus payments¹ of the Government from the inception of such payments (February 1, 1942) through 1944

	1942 (February-December)		1943		1944	
	Short tons	Percent of total	Short tons	Percent of total	Short tons ²	Percent of total
Production:						
At ceiling prices	881,711	89.23	841,286	77.12	722,791	74.
At overceiling prices:						
Under premium-price plan—						
A quotas (17 cents a pound)	102,352	10.36	217,382	19.93	194,483	20.
Special (17.01-27 cents a pound)	716	.07	14,003	1.28	26,168	2.
	103,068	10.43	231,385	21.21	220,651	22.
Metals Reserve mine contracts	³ 3,315	.34	18,147	1.67	26,347	2.
Total overceiling production	106,383	10.77	249,532	22.88	246,998	25.
Total production	988,094	100.00	1,090,818	100.00	969,789	100.1
	Total	Price per pound (cents)	Total	Price per pound (cents)	Total	Price per pound (cents)
Payments:						
Under premium-price plan—						
A quotas	\$10,306,829	17.00	\$23,138,490	17.00	\$22,065,137	17.0
Special	20,623	18.44	1,735,266	23.20	3,450,898	23.5
	10,327,452	17.01	24,873,756	17.38	25,516,035	17.7
Metals Reserve mine contracts	³ 188,117	14.84	3,488,489	21.61	4,258,562	20.0
Total overceiling payments	10,515,569	16.94	28,362,245	17.68	29,774,597	18.0
Total United States production		12.25		13.30		13.5

¹ Compiled from a report of the Office of Price Administration.

² Subject to revision.

³ Treasury (Procurement) contracts in 1942.

Average monthly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, in the United States, 1943-44, in cents per pound

Month	1943			1944		
	Domestic f. o. b. refinery ¹	Domestic f. o. b. refinery ²	Export f. o. b. refinery ²	Domestic f. o. b. refinery ¹	Domestic f. o. b. refinery ²	Export f. o. b. refinery ²
January	11.87	11.775	11.700	11.87	11.775	11.700
February	11.87	11.775	11.700	11.87	11.775	11.700
March	11.87	11.775	11.700	11.87	11.775	11.700
April	11.87	11.775	11.700	11.87	11.775	11.700
May	11.87	11.775	11.700	11.87	11.775	11.700
June	11.87	11.775	11.700	11.87	11.775	11.700
July	11.87	11.775	11.700	11.87	11.775	11.700
August	11.87	11.775	11.700	11.87	11.775	11.700
September	11.87	11.775	11.700	11.87	11.775	11.700
October	11.87	11.775	11.700	11.87	11.775	11.700
November	11.87	11.775	11.700	11.87	11.775	11.700
December	11.87	11.775	11.700	11.87	11.775	11.700
Average for year	11.87	11.775	11.700	11.87	11.775	11.700

¹ As reported by The American Metal Market Co.

² As reported by Engineering and Mining Journal.

The puts of (1942) ce ther of Price a report. ception of

quoted prices of electrolytic copper for domestic and export shipments, smelters, in the United States and for spot copper at London, 1935-44, in a pound

	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944
Electrolytic, high conductivity	8.76	9.58	13.27	10.10	11.07	11.40	11.87	11.87	11.87	11.87
Electrolytic, high conductivity, 99.7 percent	8.649	9.474	13.167	10.000	10.965	11.296	11.797	11.775	11.775	11.775
Electrolytic, high conductivity, 99.2 percent	7.538	9.230	13.018	9.695	10.727	10.770	10.901	11.684	11.770	11.770
Electrolytic, high conductivity, 99.2 percent	7.753	9.465	13.097	9.912	10.066	(¹)	(¹)	(¹)	(¹)	(¹)

Source: The American Metal Market Co.

Source: Engineering and Mining Journal.

Source: English quotations into American money based on average rates of exchange recorded by the Federal Reserve Board of Treasury.

Source: For 1940, 1941, 1942, 1943, 1944, London Metal Exchange dealings suspended for duration of war.

Price limitations, placed by the Office of Price Administration on electrolytic and casting copper, were described in earlier parts of this series. There were no changes in the ceilings in 1944. The bonus-payment plan, also described in earlier reports, permitted payment of 5 cents a pound above the ceiling price to most producers and to other producers for production from high-grade sections of mines. Special bonuses were permitted where the ceiling price plus the 5-cent bonus failed to cover mine costs, and, as shown by the foregoing table, such payments in some instances amounted as much as 27 cents, including the ceiling price. Bonuses were paid on 25 percent of production in 1944 compared with 23 percent in 1943 and 11 percent in 1942. Special bonuses were paid on less than 3 percent of total output in 1944, which was the year of greatest distribution for this purpose. Payments under special Metals Reserve Company contracts likewise covered less than 3 percent of production and also reached a peak in that year nonetheless. To official maximum prices, delivered to consumers' plants, have been added in the London market since December 18, 1939:

	Per long ton		
	£	s.	d.
Electrolytic, high conductivity	62	--	--
Electrolytic, high conductivity, 99.7 percent	62	--	--
Electrolytic, high conductivity, 99.2 percent	61	10	--
Minimum, 99.7 percent	61	--	--
Minimum, 99.2 percent	60	10	--
Cast black wire rods	65	10	--

FOREIGN TRADE³

Before the war United States imports and exports of copper constituted a well-balanced trade through which the smelting, refining, and manufacturing facilities of this country were used to treat foreign materials and to return refined copper and manufactures of copper abroad. The war has caused wide disruption of foreign trade in general and has disturbed the prewar flow of copper exports. Not only did the United States require all of the copper imported after this country's entry into the war, but most of the countries to which copper was shipped formerly were no longer appro-

Source: Imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.

appropriate markets for exports of metal from domestic plants. The general expansion in war requirements in the United States led to successive high import records in 1941 and 1942, and following a drop of 6 percent in 1943 to a new peak in 1944. Time and shipping shortages led the United States Government to give purchase and shipping priority to the highest class of copper—refined—and this class reached successive peaks in 1941 and in every year thereafter. Refined metal contributed 63 and blister 23 percent of total imports of unmanufactured copper in 1944 contrasted with 5 and 73 percent, respectively in 1939. Chile has been the chief source of imports of refined copper since the war began, as during many previous years. Noteworthy increments from Canada began in August 1944 coincidental with the period of smaller requirements for the United Kingdom. All classes except refined were received in smaller quantities in 1944 than in 1943. Chile and other Western Hemisphere sources supplied most of the blister copper, concentrates, and ore entered in 1944, as in 1943, while the Belgian Congo contributed most of the regulus and black or cast copper in both years.

The export movement since the war began has been distinguished by the sharp falling off in shipments of refined metal, formerly by the largest export class, and by the proportionately greater rise in shipments of insulated wire and cable. Exports went largely to Japan and to certain European countries—Belgium, France, Germany, Italy, Sweden, and the United Kingdom—as has been pointed out in previous reports of this series. Out of the foregoing list, it has been expedient to keep only the United Kingdom as a customer since the war began. The U. S. S. R. joined the United Kingdom as one of two principal destinations of exports of refined copper and of primary fabricated copper shapes. One of the outstanding records of the war insofar as copper is concerned, has been the enormous rise in exports of insulated wire and cable, the use of which plays such an important part in numerous war activities.

IMPORTS

The shift in emphasis from unrefined to refined copper imports since the prewar period has been striking, and this movement was continued in 1944. Receipts of refined copper established successive annual peaks beginning in 1941 (when the total was nearly four times the previous record for 1931, the year before the imposition of the 4-cent excise tax on copper), the total for 1944 being 22 percent above 1943. It seems worthwhile to repeat the comparisons given in the 1943 report of this series and to add thereto. Imports of refined made up 4 percent of the total imports of unmanufactured copper in the period 1935-53 percent in 1942, 57 percent in 1943, and 63 percent in 1944. accentuating the highest grade, shipping space was utilized to the advantage, and time was saved in delivering metal to the consuming industry. The refined metal entered since the excise tax was imposed came almost entirely from Chile until midyear 1944. Then the conditions of larger supply in the United Kingdom resulted in the shipment of increasing quantities from Canada to the United States. Imports of refined copper from Canada amounted to less than 1 percent of the total in the first 6 months of 1944 but made up 15 percent in the latter half of the year. The proportion from Canada was expected to grow in 1945. Receipts of all other classes of unma-

Imports declined in 1944 as compared with 1943: Ore decreased 18 percent; concentrates, 3 percent; regulus, black or coarse cement-copper, 10 percent; and unrefined black blister converter copper, 5 percent. Unrefined black blister is the most part of the unrefined grades, and imports of this class came mainly from Chile, Mexico, Peru, and Belgian Congo, as in 1943, the last two from the two South American countries showing increases. Black or coarse copper, comes chiefly from the Belgian Congo and receipts from that country declined in 1944. Western Hemisphere countries supplied most of the concentrates and ores in 1944 as in 1943, with Canada leading in the concentrates and Chile ahead in the ore class.

(Manufactured) imported into the United States, 1943-44, by countries, in short tons ¹

	Ore (copper content)	Concen- trates (copper content)	Regulus, black or coarse copper and cement copper (cop- per content)	Unrefined black blis- ter and con- verter copper in pigs or con- verter bars	Refined in ingots, plates, or bars	Old and scrap copper, fit only for re- manufacture, and scale and clippings
1943						
Belgium		147	10			
Canada	2,352	931	11	587		
Chile	277	195				
Congo	913	402	54,745	17,745	4,405	
France	1	82				
Germany	3,087	5,387	1,329	5,024	323	476
Italy		23,036	56	83,299	396,362	1,323
Japan		5,729				127
Peru		7,758				
Spain		2,762				
U.S.S.R.		18	409	4,442		
U.S. Lab-	417	6,008	9	14,835		
U.S. Zone		4,849				
U.S. Zone	735	3,509	49	27,277	1,672	409
U.S. Zone	2	9	1	2,342		
U.S. Zone				829		52
U.S. Zone	7,784	60,722	56,619	186,380	402,762	2,387
1944						
Belgium		156	1			
Canada		1,030	13			
Chile	343	76	112			
Congo						479
France	971	2,810	50,311	13,247		
Germany	11	20,015	14			
Italy	4,415	4,180	303	40	41,323	502
Japan		7,123	39	91,629	450,610	
Peru		3,925				
Spain	8	5				
U.S.S.R.	165	8,518	30	4,088		
U.S. Lab-		5,886		37,470		
U.S. Zone						
U.S. Zone	485	5,319	189	28,062	462	17
U.S. Zone	2	11		2,756		68
U.S. Zone	6,400	59,054	51,012	177,292	492,395	1,066

¹ Copper imported for immediate consumption plus material entering the country under

Copper (unmanufactured) imported¹ into the United States, 1940-44

Year	Short tons	Year	Short tons
1940.....	491,342	1943.....	716,787
1941.....	735,545	1944.....	787,787
1942.....	764,303		

¹ Data include copper imported for immediate consumption plus material entering country under bond.

EXPORTS

Refined copper dominated the export group, usually by a very substantial margin, from before 1900 until displaced by the wire classification in 1944. The weight of bare and insulated wire in 1944 was $2\frac{1}{4}$ times as large as refined copper so that even on a copper content basis wire largely exceeded the refined class. The share of war gains in exports of insulated wire and cable have been pointed out previously. The total for this class for 1942 was 119 percent above 1941, and 1943 was 54 percent higher than 1942; the 1944 total rose 56 percent above 1943. Attention has also been called in previous reports to the fact that exports of this class of wire furnish a guide either to the battle contestants or the battle areas. This condition continued in 1944, when the U. S. S. R. received 63 percent of the total, the United Kingdom 16 percent, and quantities of over 1,000 tons each went to India, New Zealand, and Australia. Two countries that received expanded quantities in 1943, Egypt and Algeria, were passed by the war in that year, and they dropped from the list of important export destinations of wire.

The size and destinations of exports of refined copper have changed drastically since before the war. In 1944 exports of this class dropped 61 percent from 1943 and amounted to only 22 percent of the average annual rate for 1935-39. Shipments went chiefly to the United Kingdom, the U. S. S. R., and Mexico in 1944, whereas Japan received the largest share of exports in 3 of the years 1935-39 and was a close second in the other 2; the other subsequent enemies (Germany and Italy) received large quantities throughout the period (Germany was seventh in 1939 and Italy was sixth in 1938, but otherwise they both ranked fifth or higher as export destinations). Moreover, Germany could have received much of the copper that showed in the statistics as being destined to neighboring countries such as Belgium, Netherlands, and Sweden, which were indicated to have received substantial quantities in the prewar period. The United Kingdom for many years has been one of the chief takers of copper sent from the United States, whereas the U. S. S. R. did not become an important buyer until 1939.

The U. S. S. R. also dominated exports of primary fabricated products other than insulated wire in 1944 as in 1943. These classes, however, did not account for important tonnages in either year.

	Refined		Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Insulated wire and cables	Other copper articles (value)
	Bars, ingots, or other forms	Rods						
Algeria.....	51	30		15		530	303	
Argentina.....				2		17	195	
Australia.....		(1)		4		207	1,444	
Belgian Congo.....	5	1		4		37	375	
Brazil.....	34	3		123		34	220	
Canada.....	133	140	(1)	174		38	1,913	
Chile.....	15	3		45		47	866	
Colombia.....	4	1		27		145	462	
Cuba.....	(1)	3		239		152	410	
Egypt.....	2	1		(1)	(1)	16	624	
Ireland.....		(2)		4		77	671	(1)
India and Dependencies.....	7			1		56	5,433	
Mexico.....	4,475	123		341		1	1,022	
Morocco (French).....	9	69		18		136	1,160	
New Zealand.....		1		(1)		13	3,331	
Panama: Republic of.....		(1)		2		703	111	
Peru.....	4	3		19		46	412	
U. S. S. R.....	20,971	198		6,170		5,778	91,685	
United Kingdom.....	41,507	19		(1)		39	23,653	
Uruguay.....	2	(1)	99	11		388	1,301	
Venezuela.....		(1)		28		180	1,005	
Other countries.....	1,154	44	(1)	222		1,263	8,799	
Total value.....	88,373 \$13,671,655	626 \$273,551	99 \$24,475	7,450 \$6,246,045	6,625 \$2,895,830	9,904 \$3,836,366	144,434 \$74,872,705	(1) \$859,411

¹ Changes for table in Minerals Yearbook, 1943, p. 158, are as follows: Refined bars, ingots or other forms exported to U. S. S. R. should read 1,402 short tons, China 13 tons, other countries 153 tons; wire (except insulated) exported to India and Dependencies should read 52 tons, other countries 563 tons, total 7,134 tons; insulated wire and cable exported to Brazil should read 403 tons, Canada 1,440 tons, Colombia 698 tons, Mexico 943 tons, other countries 5,693 tons.

² Less than 1 ton.

³ Figures for quantity not recorded.

⁴ United Kingdom of Great Britain and Northern Ireland.

Copper¹ exported from the United States, 1940-44

Year	Short tons		Value	Year	Short tons		Value
	Metallic ²	Total			Metallic ²	Total	
1940.....	427,650	427,944	\$108,534,217	1943.....	294,456	295,696	\$107,411,230
1941.....	158,893	158,905	46,196,275	1944.....	237,514	237,514	101,811,411
1942.....	210,518	213,942	78,563,236				

¹ Exclusive of "other copper manufactures" valued at \$1,584,441 in 1940; \$1,493,265 in 1941; \$3,759,411 in 1942; \$1,121,230 in 1943; and \$859,411 in 1944.

² Exclusive of ore, concentrates, and composition metal; exclusive also of unrefined copper, figures which are not separable from those for ore and concentrates.

Brass and bronze exported from the United States, 1943-44, by classes

Class	1943		1944	
	Short tons	Value	Short tons	Value
Ingot.....	227	\$64,161	329	\$11,500,000
Scrap and old.....	6	1,097	38	5,000
Bars and rods.....	18,750	7,123,266	23,014	7,770,000
Plates and sheets.....	75,640	29,160,228	110,045	40,440,000
Pipes and tubes.....	5,952	3,876,151	5,791	3,540,000
Pipe fittings and valves.....	1,153	1,935,113	1,006	1,850,000
Plumbers' brass goods.....	160	308,182	103	200,000
Wire of brass or bronze.....	4,490	2,326,589	3,882	2,100,000
Brass wood screws.....	(¹)	67,239	(¹)	5,000
Hinges and butts of brass or bronze.....	(¹)	27,658	(¹)	3,000
Other hardware of brass or bronze.....	(¹)	213,994	(¹)	190,000
Other brass and bronze manufactures.....	(¹)	5,251,687	(¹)	5,150,000
		50,355,365		61,500,000

¹ Weight not recorded.

Unmanufactured brass exported from the United States, 1940-44

[Ingots, bars and rods, and plates and sheets]

Year	Short tons	Value	Year	Short tons	Value
1940.....	90,907	\$30,801,796	1943.....	94,617	\$36,347,000
1941.....	39,497	14,558,425	1944.....	133,388	48,332,000
1942.....	74,129	27,860,957			

Copper sulfate (blue vitriol) exported from the United States, 1940-44

Year	Short tons	Value	Year	Short tons	Value
1940.....	27,740	\$2,293,983	1943.....	30,367	\$3,074,000
1941.....	34,511	2,950,714	1944.....	28,922	2,843,000
1942.....	35,082	3,443,922			

WORLD PRODUCTION

State data covering world production of copper since the outbreak of World War II have been unobtainable, but enough information is at hand to indicate that production has averaged roughly 40 short tons for the 3 years ended in 1944. Previous reports have stressed the fact that the United Nations and the Axis held disproportionate shares of the world total and that production strongly favored the former group. The 1943 Copper Report stated that the Axis had access to not much more than 300,000 tons, or possibly as little as 10 percent but surely not more than 24 percent of the total. In 1944 the adverse position of the Axis was worse. Germany's chief source of newly mined copper in 1940 had been the Bor mine in Yugoslavia, and supplies from this source were cut off by Germany's military reverses in the latter part of 1944. At about the same time access to Philippines copper was denied the Japanese, also because of military reverses.

REVIEW BY COUNTRIES

Australia.—Production at Australian mines is reported to have reached the high total of 31,300 metric tons in 1944. Efforts of the Commonwealth Government to increase production were relaxed in 1944 for a time early in the year it appeared that the recently opened copper production by the Mount Isa Mines, Ltd., Queensland, would be without a domestic market. Under war stimulation the mine had become the largest copper producer in Australia. Later the Government assured the company an outlet until the end of 1944, the matter being subject to review at that time. Mount Isa's ore reserves were estimated at 2,442,000 tons, assaying 3.2 percent copper. Mount Morgan, Ltd., in the same State, did not have a disposal problem but was handicapped seriously by insufficient labor. Operations at Mount Chalmers mine, 36 miles northeast of Mount Morgan, were continued by Mount Morgan, Ltd., in the first part of 1944 at least. An approximate reserve of 400,000 tons of copper ore prompted reopening of this mine. Mount Lyell Mining & Railway Co., Ltd., Tasmania, was regularly the largest producer in Australia before the war. Labor problems beset this company also in 1944, and production fell. Reserves for the fiscal year ended September 30 were estimated at 12,882,000 tons having an average copper content of 1.14 percent.

Bolivia.—Production amounted to 6,170 metric tons in 1944 compared with 6,011 tons in 1943. The Metals Reserve Company contract to purchase copper in Bolivia expired on March 1, but the Banco Boliviano purchased the outputs of small miners during that month. Such as the American Smelting & Refining Co., by far the largest purchaser in the country, was not a party to the Metals Reserve Company contract, the effect of its expiration was expected to be slight.

World mine and smelter production of copper, 1939-44, in metric tons

[Compiled by B. B. Waldbauer]

Country	Mine					Smelter						
	1939	1940	1941	1942	1943	1944	1939	1940	1941	1942	1943	1944
North America:												
Canada:	276,157	297,371	291,802	273,819	280,900	248,542	1,229,367	1,256,294	1,254,489	1,244,040	1,232,740	1,224,437
Cuba:	9,964	9,559	9,838	78,916	6,405	6,584	39,045	31,252	40,914	44,729	43,013	32,974
Mexico:	44,390	37,602	48,716	51,379	49,774	41,302	39,045	31,252	40,914	44,729	43,013	32,974
Newfoundland:	10,341	9,426	6,651	5,666	5,669	5,021	698,323	922,364	1,015,346	1,111,458	1,103,918	1,022,382
United States:	640,717	796,582	869,214	979,811	989,568	882,277	966,735	1,209,910	1,310,749	1,400,227	1,379,671	1,279,793
South America:												
Bolivia:	4,056	6,660	7,274	6,376	6,011	6,170	324,591	336,861	453,594	477,733	489,320	490,441
Chile:	339,173	352,010	465,467	499,158	506,378	487,600	324,591	336,861	453,594	477,733	489,320	490,441
Ecuador:	2	3,209	3,462	3,157	4,418	3,720	34,115	33,678	28,269	29,473	28,215	26,888
Peru:	35,616	43,965	36,822	35,332	33,407	32,390	34,115	33,678	28,269	29,473	28,215	26,888
Europe:												
Belgium:	320	560	(7)	(7)	(7)	(7)	65,850	(7)	(7)	(7)	(7)	(7)
Bulgaria:	11,797	20,000	18,000	18,000	18,000	(7)	13,246	18,000	18,000	18,000	18,000	(7)
France:	30,000	35,800	101	65	25	(7)	1,701	932	659	407	118	122
Germany:	30,000	35,800	(7)	(7)	(7)	(7)	66,000	(7)	(7)	(7)	(7)	(7)
Austria:	(7)	(7)	(7)	(7)	(7)	(7)	66,000	(7)	(7)	(7)	(7)	(7)
Hungary:	846	1,372	1,288	(7)	(7)	(7)	2,577	2,439	2,917	(7)	(7)	(7)
Italy:	20,358	20,000	(7)	(7)	(7)	(7)	10,458	6,730	5,017	4,251	2,003	(7)
Norway:	(7)	(7)	(7)	(7)	(7)	(7)	600	(7)	(7)	(7)	(7)	(7)
Portugal:	(7)	(7)	(7)	(7)	(7)	(7)	600	(7)	(7)	(7)	(7)	(7)
Rumania:	(7)	(7)	(7)	(7)	(7)	(7)	600	(7)	(7)	(7)	(7)	(7)
Spain:	(7)	(7)	(7)	(7)	(7)	(7)	600	(7)	(7)	(7)	(7)	(7)
Sweden:	9,610	157,000	(7)	(7)	(7)	(7)	10,445	9,422	8,900	11,590	10,952	10,590
U. S. S. R.:	11,305,548	(7)	(7)	11,160,000	(7)	(7)	11,076	13,307	12,700	12,000	13,000	14,500
United Kingdom:	64,200	(7)	(7)	(7)	(7)	(7)	130,548	157,000	12,700	13,000	13,000	14,500
Yugoslavia:	(7)	(7)	(7)	(7)	(7)	(7)	4,000	4,500	(7)	(7)	(7)	(7)
	(7)	(7)	(7)	(7)	(7)	(7)	41,658	42,951	(7)	(7)	80,000	(7)
	(7)	(7)	(7)	(7)	(7)	(7)	358,159	(7)	(7)	(7)	(7)	(7)

	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911	2912	2913	2914	2915	2916	2917	2918	2919	2920	2921	2922	2923	2924	2925	2926	2927	2928	2929	2930	2931	2932	2933	2934	2935	2936	2937	2938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Canada.—Canadian mine production has dropped in each year since the peak rate was reached in 1940; the total for 1944 was 273,972 short tons compared with 287,595 tons in 1943, 301,831 in 1942, 321,658 in 1941 and 327,797 in 1940. Labor shortages were the principal cause of the declines. Production of refined copper made a slight gain in 1944, or from 251,495 tons in 1943 to 251,871 tons. The refined copper is produced at the Copper Cliff plant of the International Nickel Co. of Canada, Ltd., and the Montreal East plant of Noranda Mines Ltd. The chief Canadian mines contracted with the British Government at the beginning of the war for most of their output. These contracts were terminated on January 31, 1945, but producers' fears that their copper would lack a market proved without immediate foundation, at least, because of the continuing demand for enormous quantities of copper in the United States. Canadian copper producers appear to be in a favorable position to compete in postwar markets. Most of the copper produced in Canada comes from ores that have high values in other metals, such as nickel-copper and zinc-copper ores. Because of this condition the copper content does not need to carry its share of the costs of production. Mine production, by Provinces, is shown in the accompanying table.

Copper produced (mine output) in Canada, 1940-44, by Provinces, in short tons

Province	1940	1941	1942	1943	1944 (preliminary)
British Columbia	38,871	33,164	25,008	21,111	18,000
Manitoba	37,634	33,509	23,798	19,008	21,900
Ontario	173,966	166,915	154,141	138,920	141,800
Quebec	67,083	71,892	70,456	65,582	55,200
Saskatchewan	10,243	16,162	28,391	42,974	36,900
	327,797	321,658	301,831	287,595	273,972

¹ Includes Northwest Territories.

As usual, more than half of the Canadian production came from the nickel-copper mines of the Sudbury district, Ontario, and the International Nickel Co. of Canada, Ltd., was again the principal copper producer. This company's sales of copper in all forms, derived from company mines, amounted to 134,503 short tons in 1944, representing a small increase over the 132,744 tons in 1943. The Falconbridge Nickel Mines, Ltd., the other important producer in Ontario, hoisted 829,392 tons of ore in 1944 and treated 830,254 tons for the recovery of 6,383 tons of copper in matte. The company reported reserves at the end of 1944 to be 12,669,500 tons of ore, averaging 1.7 percent nickel and 0.93 percent copper, of which 7,995,500 tons were in the Falconbridge mine. Both companies complained of labor shortages in 1944.

Quebec ranks second as a copper-producing Province, but output in this area amounts regularly to less than half of that for Ontario. In 1944 the ratio was 1 : 2.6. Noranda Mines, Ltd., is the principal producer in Quebec. A total of 1,553,857 tons of ore was hoisted at the Horne mine in 1944. Ore and concentrates from the Horne mine totaling 703,153 tons, were smelted; and 28,290 tons of copper, 196,400 ounces of gold, and 508,126 ounces of silver were produced. Custom material totaling 345,285 tons also was smelted, and the total

gray and custom copper was 56,543 tons. Ore reserves above 1,355-foot level on January 1, 1945, totaled 5,266,000 tons averaging 2.88 percent copper and 15,997,000 tons containing 0.80 percent, some siliceous fluxing ore. The decline in ore reserves resulted in labor shortages that prevented the carrying on of adequate equipment. Operations at the property of the Normetal Mining Corporation, Ltd., were handicapped by the inadequacy of the power as well as by a labor shortage. Ore reserves, after 192,994 tons were treated in 1944, amounted to 1,380,000 tons. Waite Mines, Ltd., produced 20,500 tons of copper in 1944, the decrease from nearly 25,000 in 1943 being due mainly to the insufficient supply. Ore reserves for Waite Amulet and Amulet Dufault totaled approximately 3,000,000 tons at the end of 1944. Canadian Copper Refiners, Ltd., Montreal East, produced 103,000 tons of copper, 396,000 ounces of gold, and 3,380,000 ounces of silver. The company was constructing a new copper sulfate plant, which was expected to go into production before the middle of 1945. The company of the new plant was expected to take care of Canadian requirements for copper sulfate.

The copper produced in Manitoba and Saskatchewan comes regularly from the Flin Flon mine of the Hudson Bay Mining & Smelting Co., Ltd., and the Sherritt Gordon Mines, Ltd., and in 1944 the old Mandy shaft operated by Emergency Metals, Ltd.—a wholly owned subsidiary of the Hudson Bay company—contributed to the total output. At the Flin Flon mine 2,059,206 tons of ore were mined and milled, and 2,027,926 tons were milled. Ore and concentrates treated at the copper plant for company account yielded 43,241 tons of copper, 145,441 ounces of gold, and 2,017,443 ounces of silver. The most recent calculation of reserves for Flin Flon was for January 1943. At that time, 27,378,240 tons of ore averaging 2.59 percent copper were estimated to be in the ground. Sherritt Gordon Mines, Ltd., produced 12,271 tons of copper from 731,783 tons of ore mined and milled, compared with 13,480 tons of copper and 770,099 tons of zinc, respectively, for 1943. Production in 1944 also included 7,059 ounces of gold, 226,349 ounces of silver, and 23,910 tons of zinc concentrate. Total copper ore reserves at the end of 1944 were calculated to be 2,175,000 tons, averaging 2.59 percent copper and 2.20 percent zinc. Emergency Metals, Ltd., completed mining and milling all the down ore tributary to the old Mandy shaft, and this operation was terminated. The 62,227 tons of ore milled yielded 3,000 tons of copper, 5,322 tons of zinc, 3,501 ounces of gold, and 69,265 ounces of silver.

In British Columbia output of the mines of Granby Consolidated Mining & Power Co., Ltd., and the Britannia Mining & Smelting Co., Ltd., was under contract in 1944 to the United States Government. Labor shortages impeded operations in this area also.

Chile.—Activity at copper mines continued to be influenced by the heavy military requirements of the United States, to which virtually all of Chile's copper has been destined during World War II. Production in 1944 failed by a narrow margin to equal the high record rates for 1943 and 1942; 487,600 metric tons were produced compared with 509,378 and 489,158 tons, respectively. Smelter output totaled 490,441 tons in 1944 compared with 489,320 in 1943, both of which represented respective records. During the year the press reflected

the growing realization in Chile that the tremendous expansion in copper production due to the war and the inflationary effects on the national economy caused by the war presented serious problems in the postwar era; it also pointed out that the United States had a responsibility in the solution of the problems created. Copper is Chile's principal export. Costs of production have increased sharply during the war; and prewar markets, chiefly in Europe, will be susceptible to competition from other large copper-exporting countries after the war ends.

Since February 1, 1942, the smelters at Chagres and Natalgua have been operated by the U. S. Commercial Company (successor in this enterprise to the Metals Reserve Company) on a "cost-plus" basis. The contracts were scheduled to be terminated on January 31, 1943, but they were extended. For a number of years these smelters have depended for a major part of their smelter feed on ores and concentrates purchased from small operators. Some of the material shipped a considerable distance. The high cost of operation by small producers makes their continued production under competitive conditions problematical. Small producers have contributed a relatively unimportant percentage of total output.

The Chilean Government has imposed a number of different kinds of taxes on copper, and taxes have been increased during the war. A special tax calls for the payment after the price has reached 10 cents a pound at New York of the next 1½ cents to the Government, the following 1½ cents going to the producer.

Exports of electrolytic copper totaled 274,663 metric tons, of which 256,286 went to the United States, 16,235 to Brazil, and the remainder to other South American neighbors. Standard copper exports amounted to 217,209 tons, of which 214,121 went to the United States, 2,811 to Brazil, and the remainder to other South American countries. The quantities for electrolytic copper for 1943 were 245,117, 240,291, and 3,035 tons, respectively, and those for standard for 1943 were 211,057, 210,517, and 520, respectively. Ore exports totaled 20,811 tons in 1944, compared with 9,340 in 1943. Concentrates aggregated 6,937 and 3,879 tons, respectively. Total ore and concentrates for both years went to the United States.

Cyprus.—Copper mines and mining in Cyprus were described recently by Classen.⁵ Copper is the most important mineral of this island, and the present productive mines operate on sites once worked by the Phoenicians and the Romans. The Skouriotissa and Mavrovouni mines, in the Bay of Morphou, show extensive traces of Roman and Phoenician work and may be considered to have been the largest producers in those times. These mines were rediscovered in 1913 and began production in 1922, under ownership of an American company. The Skouriotissa ore body is a lenticular mass of cupriferous pyrite lying nearly horizontal, 1,900 feet long, 800 feet wide, and not more than 140 feet thick. A typical analysis shows about 2 percent copper. The Mavrovouni mine lies about 3 miles west of Skouriotissa, and the ore body resembles a pear in shape, standing on its base. The known ore body extends from about 300 feet above sea level to a depth of some 700 feet, but it has not been delimited. The ore is similar to

⁵ Classen, G. A., Impressions of Mining in Cyprus: Mining Jour. (London), vol. 224, No. 5719, Mar. 31, 1945, pp. 197-199. (Excerpts from a paper which appears in Bulletin 59 (1944) of the Kolar Gold Field Mining and Metallurgical Society.)

and the Skouriotissa, but its copper content is roughly three times as great, and the sulfur content is less. A flotation plant at the mine treats ore from both of the properties described. Other copper properties on Cyprus are the Limni mine in the northwest in the Bay of Chrysokhou, and the Kalavasso mines in the foothills east of Troodos, about 10 miles inland from the south coast. The Limni mine has never been operated; but the Kalavasso mines, which are reported to be extensive, began to produce in the months preceding World War II.

Northern Rhodesia.—Early in 1944 copper producers in Northern Rhodesia anticipated a production cut of 20 to 25 percent, due to the fact that copper supplies of the United Nations were less scarce at that time than for many previous months. The United Kingdom—then the chief destination of exports of Northern Rhodesia copper—after the beginning of the war—appeared to have sufficient supplies for all foreseeable requirements. Continuing large needs of other nations, however, made such a sharp cut inadvisable, and the plan to reduce production was modified. Production in 1944 amounted to about 225,000 tons, or 10 percent less than in 1943. In the latter part of the year copper producers in Northern Rhodesia, like those in Canada, looked forward to the termination early in 1945 of their war contracts with the British Government. The British Government informed the producing companies that contracts would not be renewed at the end of January 1945. The tremendous need of the military branches of the United States Government for matériel containing copper, however, postponed the problem somewhat, and late in 1944 the Governor of Rhodesia announced that production for at least the first quarter of 1945 would go to the United States. At a meeting of the delegates of the Chamber of Mines, the Officials' Association, and the Mine Workers Union at Lusaka, November 28, 1944, the Governor spoke concerning the future for copper, the principal industry of the country, and said, among other things, that Northern Rhodesia was not the world's cheapest producer owing in large part to the long, expensive rail haul to tidewater.

Again in 1944 copper companies were unable to publish any production figures for the fiscal year ended June 30. The May, June, and July 1944 issues of the Engineering and Mining Journal contained articles by Raymond Brooks on the discovery and development of Rhodesian copper properties.

Philippines.—The situation in regard to copper mining in the Philippines since the Japanese invasion was described by Bain.⁶ The following is quoted from his article:

The mining of copper and the making of brass are ancient Japanese industries. Not many years ago Japan stood next after the United States, and second in the world in copper production. Since then our own production has greatly increased, and Chile, Rhodesia, Canada and the Belgian Congo have risen to high rank as copper producers. Japan's production has also grown, but not nearly enough to enable her to maintain her old position as a producer.

In the years preceding the present war, Japan's domestic production stood at about 70,000 tons, which seemed to meet demands for consumption. Immediately before the war she purchased as much more abroad, mainly from the United States. In the most recent of those years she purchased enough ores and concentrates from Canada, Chile, and the Philippines to enable her furnaces to push production up to possibly 100,000 tons per year, much of which undoubtedly went into war storage. Imports were all cut off by the war. But early in 1942

⁶Bain, H. Foster, *Japan's Power of Resistance*: Foreign Affairs, vol. 22, No. 3, April 1944, p. 430.

the Japanese took possession of the Lepanto mine in the Philippines, from which they had previously been buying ore, and began to operate it. Incidentally, they found more than a million dollars' worth of ore and concentrate which had accumulated at the shore after shipments stopped. The mine had been producing at the rate of 11,000 tons of copper per year. The Japanese spared neither work nor expense to increase the output and have been very successful. They opened additional workings and were fortunate in finding richer ore. They moved in additional machinery from gold mines in Northern Luzon, improved shipping facilities from mine to shore, and, contrary to their policy elsewhere, raised wages and paid workers a premium for regularity in attendance. They are even reported to have issued gasoline to the large number of trucks plying between mine and dock. This is the only place in the Philippines where the issuance of gasoline for other than strictly military equipment has been reported.

These measures indicate that copper is one of the items most needed to carry out the Japanese program. The belief is reinforced by the news that has come of the widespread campaign for copper scrap under way in the Philippines and elsewhere and of the imposition, in the fall of 1943, of control measures over the use of copper wire. In addition, the Japanese are making efforts to develop mines out of small prospects in the central islands of the Philippines. All these various efforts seem to have been well-rewarded. From Lepanto alone by the end of 1943 copper was being drawn at a rate of about 36,000 tons per year, equal to half the normal output of the mines in Japan proper; and active steps were being taken to build up production still further. American submarines had sunk at least two cargoes of concentrate. In this instance Japan can nevertheless be said to have succeeded in deriving notable profit from an occupied country.

The activity of the American fleet in Philippine waters in the third quarter of 1944, the American invasion of the islands in October, and subsequent events in connection with the war probably cost Japan access to all of the copper of the Philippines before the end of the year.

Turkey.—The two chief copper areas in Turkey are at Erganimaden and Murgul. Until recently some blister copper was produced at Kuvashan near Murgul, but reserves at this property are reported to be near exhaustion. All three properties are subsidiaries of Eti Bank. Ergani is the principal producer. It is said to have a large indicated reserve of ore containing 6.5 to 10 percent copper. Eti Bank reported that the average grade of ore produced in 1944 was 7.99 percent. Mining is by open-pit methods, and the property is equipped with a smelter and small fire-refining plant. Blister output, in metric tons, is reported as follows: 1939, 4,236; 1940, 4,754; 1941, 8,100; 1942, 5,180; and 1943, 7,030. Refined copper is reported as follows: 1939, none; 1940, 2,076; 1941, 910; 1942, 2,205; and 2,200 in 1943. Plans call for larger production of blister copper in 1945, but a shortage of refractory brick may result in the closing of the plant. The predominant ore minerals at Murgul are pyrite, chalcopyrite, and bornite. The average tenor of ore is reported to be about 2½ percent copper. "Uncovered" reserves in 1943 were reported as 2,000,000 tons. New equipment to be installed at this mine after the war comprises a 1500-ton flotation mill and a smelter. The following amounts of blister copper were recovered from ore at the Kurvashan mine: 1939, 2,500 metric tons; 1940, 1,924; 1941, 1,417; 1942, 857 and 1943, 485. There are two small electrolytic installations in Turkey, one at the Turkish military factory at Karik Kale and the other, privately owned, at Yunus near Istanbul.

United Kingdom.—The turning point in the supply-requirements balance for the United Kingdom was reached in 1944, and at the end of the year the British Government was planning cancellation of contracts with Empire producers and release of copper to the United States under reverse Lend-Lease arrangements. Announcement was

essentially that contracts with producers would not be renewed after January 31, 1945. Market reports in December stated that for all applications for metal for civilian consumption were reviewed sympathetically, the principal difficulty being that permission for use of metal was contingent on the provision that the use should not take labor from priority work. In a statement in the Metal Market (London) of July 14, 1944, consumption of new copper from the beginning of World War II to the end of 1942 was estimated to be more than doubled. Consumption, according to the article, rose from 300,000 or possibly 600,000 tons a year, compared with an annual average of about 251,000 tons in 1934-38. The United Kingdom is one of the largest copper-importing countries; according to the Metal Market (London) of January 5, 1945, imports reached 492,000 tons in 1943, compared with a prewar average of 262,000 tons. These imports cover what is termed "retained imports." An article in the December 16, 1944, issue of the American Metal Market indicates that it happened to British exports of copper and brass materials as a result of the war, as follows:

Copper and brass exported from Great Britain, 1938 and 1943, in long tons (reexports and shipments for use of United Kingdom forces abroad excluded)

	1938	1943
Sheet (including rough)	10,468	111
Bars, sheets, strips, etc.	4,365	1,577
Wires and rods	11,349	2,137
Castings	1,298	693
Manufactures	4,935	1,137
Alloys of copper (other than nickel):		
Bars, sheets, etc.	3,218	370
Wires, rods, strips, etc.	7,489	461
Castings, etc.	1,845	1,046
Manufactures	1,702	1,092
Brass	1,223	712
Manufactures	6,095	2,370

Yugoslavia.—The famous Bor mine, located near Zajecar in the district of Moravska, about 90 miles southeast of Belgrade, was taken back from the Germans by the Yugoslav Partisan forces in the last quarter of 1944, thus denying to Germany what had been its chief source of newly mined copper since June 1940. Owing to conditions prevailing in Yugoslavia during much of the war period, there is considerable doubt that the Germans were able to maintain production at near capacity levels despite their desperate need for this metal. Mine production, so far as data are available, was 64,200 metric tons in 1939. According to the Mining Journal (London) of March 1945, the speedy advance of the Yugoslav and Russian armies prevented planned demolition at the property, but 3 months were required, nevertheless, to make necessary repairs to mine, foundry, and blast furnaces.

LEAD¹

By ALFRED L. RANSOME

SUMMARY OUTLINE

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GENERAL SUMMARY

The outstanding feature of the lead industry in 1944 was the decrease in new supplies, which failed to balance a high level of consumption. Production from domestic mines, which is the principal source of new supply, continued to decline, largely owing to a severe shortage of manpower. Imports of refined lead—a ready source of immediately usable metal—were lower, consumption was maintained at a high level, and Government stocks of refined lead were steadily reduced to a point considered below the margin of safety. At the end of the year a sweeping revision of existing General Preference Order M-38 was announced by the War Production Board to restrict consumption further and thereby help to ease a situation that had grown critical. The end of the European phase of the war in May 1945 was accompanied by signs of gradually diminishing military requirements, but the backlog of civilian needs for lead during the period of partial reconversion will maintain demand at a high level. The prospect for 1945 is one of the continuing insufficient supply for all potential consumers but of adequate supply for military and essential civilian requirements.

Refined primary lead production from domestic and foreign ores and foreign base bullion decreased 1 percent in 1944, the total being only 4,849 short tons less than the 1943 output. Year-end stocks at domestic refineries (physical inventory) were less than half the total at the beginning, and consumers' inventories were 22 percent lower.

Total imports of lead in all forms during 1944 showed a gain of less than 1 percent. An increase in receipts of lead in ore, concentrates, and matte—largely from Newfoundland and Australia—offset a decline in imports of refined lead, the principal source of which was Mexico. A substantial amount of reclaimed lead and lead scrap from Australia partly balanced the absence of base bullion from that country.

The established price of 6.50 cents a pound for lead at New York remained unchanged throughout 1944.

¹ This report deals primarily with the smelting, refining, and consuming phases of the industry. For full details of mining operations, see separate reports issued for the various States.

Statistics of the lead industry in the United States, 1925-29 (average) and 1940-44, in short tons

	1925-29 (average)	1940	1941	1942	1943	1944
Quantity of refined primary lead:						
From domestic ores and base bullion	660,525	433,065	470,517	467,367	1,406,544	394,443
From foreign ores and base bullion	123,104	100,114	100,450	99,472	163,068	70,320
Total refined primary lead	783,629	533,179	570,967	566,839	1,469,612	464,763
Quantity of secondary lead	280,000	260,346	397,416	323,001	342,094	331,416
Total refined lead						
Lead in pigs, bars, and old	4,592	151,568	274,395	369,254	244,510	226,071
Lead in base bullion	95,747	19,624	24,704	43,855	4,583	58
Lead in ores and matte	40,096	111,300	82,115	79,362	70,023	95,216
Lead in refined pig lead	98,048	149,079	14,359	15,814	13,261	15,523
Lead remaining in bonded warehouse at end of period	136,969	211,876	156,286	(¹)	(¹)	(¹)
Total primary lead apparently shipped to domestic consumers	690,916	633,989	812,863	669,840	1,777,661	775,095
Total consumption of primary and secondary lead	900,250	782,000	1,050,000	1,043,000	1,113,000	1,119,000
New York:						
Average for year						
cents per pound	7.47	5.18	5.79	6.48	6.50	6.50
Quotation at end of year	6.25	5.50	5.85	6.50	6.50	6.50
London average	5.87	(¹)	(¹)	(¹)	(¹)	(¹)
Production of recoverable lead	664,230	457,392	461,426	496,239	453,313	416,861
Smelter production of lead	1,850,000	(¹)	(¹)	(¹)	(¹)	(¹)

Noted figure.

¹ Data include lead imported for immediate consumption plus material entering the country under bond. Includes 25,324 tons of foreign refined lead reexported, according to American Bureau of Metal Statistics; figures not available.

² Includes 3,574 tons of foreign lead reexported in 1942 and 11,258 tons in 1943, according to records of U. S. Department of Commerce.

³ Data not available.

⁴ Official maximum price fixed by British Ministry of Supply at £25 per long ton.

Figure 1 shows trends in the domestic lead industry since 1900.

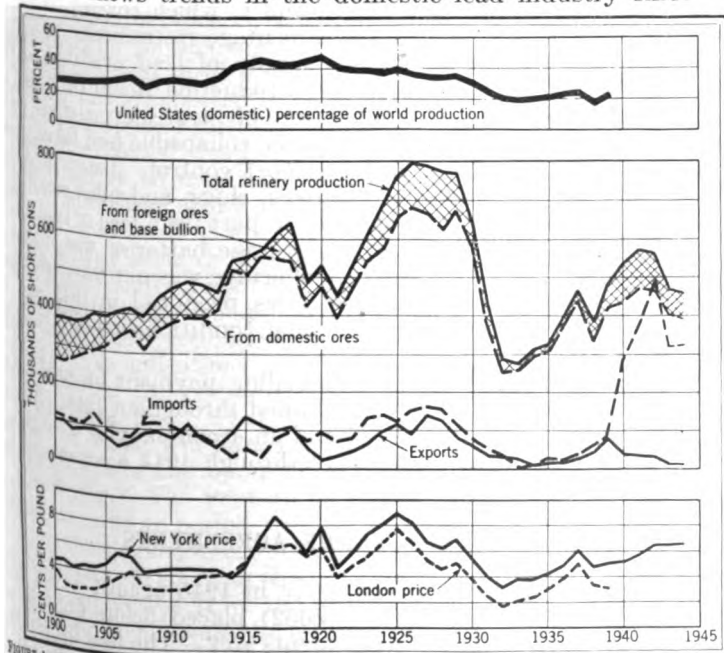


Figure 1.—Trends in the lead industry in the United States, 1900-1944. Imports include lead in ore, base bullion, pig lead, and scrap; exports include pigs, bars, and scrap lead exported in manufactures with benefit of draw-back. Data on lead exported in manufactures with benefit of draw-back not available for 1944.

WAR AGENCY REGULATIONS

Lead remained under Government control throughout 1944, under War Production Board General Preference Order M-38, which provides for the regulation of shipments, deliveries, and a reserve pool for allocation. In actual practice the control of lead was confined to the allocation of Government-owned stocks of foreign lead and to prohibition of the use of lead for certain purposes; all essential uses were freed from control, subject, of course, to limitations imposed by virtue of regulations on the use of other materials needed for the manufacture of lead-containing products. As a result of a decrease in new supplies and Government stocks of refined lead were steadily reduced. To help ease the resultant critical supply position the War Production Board amended Order M-38, effective December 26, to restrict most civilian uses of lead to an annual rate of 60 percent of the 1944 level of consumption. Under the revised order, restrictions and availability of lead were defined under three listings: A, prohibited uses; B, end uses for storage batteries, cable covering, tetraethyl, and ammunition for military use only (for which lead was made available 100 percent) and for solders, bearing metals, brass and bronze for which the use of lead was unrestricted; and C, the greater portion of civilian uses with the restriction mentioned above. Greater restrictions were placed on other than essential uses by an amendment to the order on January 15, 1945, followed by the prohibition of certain end uses in the order by another amendment on February 1. Because the lead supply became increasingly critical, permissible uses of the metal were again curtailed, in an amendment to the order on March 31, to include only end products. A list of 64 permissible uses was substituted for the previous lists A, B, and C which covered restricted uses, unrestricted uses, and quota percentage restrictions.

To conserve further the foreign supply of lead available to the United States for war purposes, War Production Board General Imports Order M-63—governing imports of strategic materials—was amended, effective February 14, to place collapsible lead tubes, storage batteries, and lead foil under import control. Later, in April, another amendment included lead disks, slugs, and other semifabricated forms manufactured in whole or in part from lead or lead alloy.

Limitation Order L-180, affecting storage batteries, was amended in April 1945, to insure that the lead shortage was not reflected in the quality of replacement storage batteries produced in 1945 and to prevent the sale of batteries except under conditions in which replacement was imperative.

The Premium Price Plan for overceiling payment for production of lead in excess of quotas was maintained throughout 1944. A brief outline of the Premium Price Plan and an accompanying table giving production and payments from 1942 through 1944 are given in this chapter under the heading Prices.

RECIPROCAL TRADE AGREEMENTS

Marked opposition was voiced early in 1945 against certain proposals embodied in a bill (H. R. 2652) placed before Congress to extend the Reciprocal Trade Agreements Act. The lead industry as a whole opposed the proposed delegation of power to the President to make a further cut of 50 percent in the rates of duty prevailing

January 1, 1945, and asked that any extension of the act be limited to the war. The cause for alarm was certain language in the measure that could be interpreted to make permanent the temporary 50-percent reduction under the existing Mexican Trade Agreement of 1942. As finally written and passed by the Senate on June 19, the measure extends the act for 3 years and allows for as much as 50-percent reduction in the rates of duty prevailing on January 1. Any temporary reduction under wartime agreements remain temporary, however, and any cut in the duty will be with respect to the rates established by the 1930 tariff act. Under the "most-favored-nation" principle, any reduction embodied in a reciprocal agreement would apply equally to virtually all countries.

POSTWAR OUTLOOK

The outlook for lead for the few years following the war depends on the interrelated factors of production, imports and tariffs, consumption, and price. These in turn depend to a great extent on the outcome of the war in the Pacific and how soon the vast domestic productive capacity—as a whole—can be directed to peacetime pursuits under competitive conditions.

Production.—Mine production during the war period failed to reach the peacetime 1925–29 average of 664,230 tons owing to depletion of ore reserves in certain districts and to a general scarcity of manpower. A considerable proportion of the output since 1939 was reduced at the expense of the prospecting and development necessary to the sustained economic operation of a mine. The postwar availability of labor will not make up for depleted reserves, and some time will elapse before development can be again placed in a normal position in relation to actual mining. Conceivably domestic mines could fill the demand for new lead for a limited time, given adequate price and tariff protection, but the past partial dependence on foreign lead is expected to continue to an increasing extent as our resources are drained further.

Imports.—Postwar readjustments of international trade will be accompanied by an inevitable competitive world market for refined lead. The smelting countries—particularly those that depend largely on imported ore, such as France, Belgium, and the United Kingdom—will be actively seeking for such raw material in the very countries that were the source for much of our supply during the war period. In all probability such supplies as we may need will have to come from the Western Hemisphere—principally Mexico—in ore and as refined lead, as indications point to the production of other countries being absorbed by expanded industry at home and by shipment elsewhere than the United States. Any future lowering of tariff barriers, of course, will have its effect upon the flow of materials into the United States and upon domestic production.

Consumption.—The pent-up consumer demand to be filled in the immediate postwar period will result in an annual consumption of new lead as metal and in ore of at least 500,000 tons—probably more—for some years. Aside from the large potential consumption of lead in batteries and tetraethyl for the forthcoming resumption of the manufacture of automobiles and their operation, the quantity of lead needed

for postwar construction at home and reconstruction abroad will far toward balancing the decreased use for direct military purposes.

Price.—Bonuses and premiums probably will be dropped eventually and prices freed of all control and allowed to return to a condition of normal fluctuations in a competitive market. In the absence of control, the price for lead immediately after the war may rise above the established wartime ceiling, but it is probable—taking the longer term view—that the price will be lower than at present, although not as low as the general prewar level. Assuming that some tariff protection will remain in force, the factors of demand by consumers and higher production cost to smelters and refiners will tend to keep the price on a plane relative to an expected generally higher-cost level for all commodities. The marked reduction in stocks during 1944 has largely precluded any possibility of postwar dumping of excess inventories of lead on the market with a resultant depressing effect upon the price. Further protection against such a possibility is given by the Surplus Property Act of 1944, which provides for stock-piling excess materials owned by the Government.

DOMESTIC PRODUCTION

Pig lead is produced at primary plants that treat ore, base bullion and small quantities of scrap and at secondary plants that process scrap exclusively. Both types of plants may make refined lead or antimonial lead. Because of the large quantity of hard lead—such as battery scrap—melted at secondary smelters, the output from this type of operation is essentially antimonial lead alloys. Figures for the production of refined lead and alloys at secondary plants are given in the section on Secondary Lead. The 17 smelters and refiners in the United States canvassed in 1944 (including one smaller smelter which reported for the first time) consumed 477,765 short tons (lead content) of ore, only 15 percent of which originated in foreign countries.

REFINED LEAD

Despite the continuing labor shortage, the 10 primary refineries in the United States were able to produce 476,131 tons of refined lead, 1 percent above the 1943 output of 471,475 tons.

Refined lead produced at primary refineries in the United States, by sources, 1940-44, in short tons

Source	1940	1941	1942	1943	1944
Refined lead:					
From domestic ores and base bullion ..	433,065	470,517	467,367	¹ 406,544	394,443
From foreign ores ..	83,563	74,166	81,485	¹ 62,936	70,225
From foreign base bullion ..	16,551	26,284	17,987	¹ 132	95
Total from primary sources ..	533,179	570,967	566,839	¹ 469,612	464,763
From scrap ..	16,588	13,454	12,856	¹ 1,863	11,368
Total refined lead ..	549,767	584,421	579,695	471,475	476,131
Average sales price per pound ..	\$0.050	\$0.057	\$0.063	\$0.064	\$0.064
Total calculated value of primary refined lead ² ..	\$53,318,000	\$65,090,000	\$71,422,000	\$60,110,000	\$59,490,000

¹ Revised figure.

² Excludes value of refined lead produced from scrap at primary refineries.

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	1944
544	394,443
436	70,225
132	96
612	464,763
963	11,908
475	476,131
964	30,064
900	\$52,490,000

Of the 464,763 tons of primary lead produced in 1944, domestic ores and base bullion supplied 85 percent, and 15 percent was derived from foreign ores and imported base bullion. In 1943 the origin was 87 percent domestic and 13 percent foreign. Again, as in 1943, the quantity of refined lead produced from foreign base bullion was negligible. Imports of this material, from Mexico and Peru, amounted to only a few tons. This suggests that practically the entire Mexican production of base bullion (a large proportion of which was exported to the United States each year before 1942) continues to be refined in Mexico. The following table gives the production of refined lead by country of origin of the ore. Details of the sources of lead from domestic ores are given in the section on Mine Production.

Refined primary lead produced in the United States, by country of origin, 1940-44, in short tons

Source	1940	1941	1942	1943 ¹	1944
Domestic ore and base bullion.....	433,065	470,517	467,367	406,544	394,443
Foreign ore:					
Australia.....	14,856	19,561	19,638	16,180	22,210
Canada.....	9,009	5,708	5,980	4,537	7,461
Europe.....	3,650	123	14		
Mexico.....	1,303	390	2,403	2,213	5,250
South America.....	34,744	27,173	23,127	9,610	13,434
Other foreign.....	20,001	21,211	30,323	30,396	21,870
	83,563	74,166	81,485	62,936	70,225
Foreign base bullion:					
Australia.....		831	16,902		
Mexico.....	16,161	25,358	111	60	58
South America.....		47	216	72	37
Other foreign.....	390	48	758		
	16,551	26,284	17,987	132	95
Total foreign.....	100,114	100,450	99,472	63,068	70,320
Grand total.....	533,179	570,967	566,839	469,612	464,763

¹Revised figures.

ANTIMONIAL LEAD

Antimonial lead production at primary refineries decreased 8 percent to 57,902 tons in 1944. The distribution of the lead is shown in the following table, according to source. The marked increase in the lead content recovered from scrap in 1943 and 1944 is due largely to the greater quantity of battery lead plates being smelted for the specific production of antimonial lead. The antimony content showed an increase for the first time since 1940. The probable reason for this increase to 8.1 percent antimony in 1944 from 5.3 percent in 1943 is the decrease in small-arms ammunition production in 1944 and consequent smaller demand for the lower percentage antimonial lead used for bullet core rod. In addition to antimonial lead produced as a byproduct of the process of refining base bullion, a much larger quantity was obtained from smelting antimonial lead scrap at secondary smelters. Production data from lead-smelting plants handling scrap materials exclusively are summarized in the following section and discussed in detail in the chapter on Secondary Metals—Non-ferrous.

Antimonial lead produced at primary lead refineries in the United States, 1940-44

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1940.....	29,762	2,944	9.9	7,364	3,023	16,431	26,81
1941.....	40,237	3,510	8.7	14,852	8,013	13,862	36,72
1942.....	51,762	3,524	6.8	24,512	12,165	11,561	48,23
1943.....	63,515	3,371	5.3	16,674	10,583	32,887	60,14
1944.....	57,902	4,670	8.1	13,280	5,477	34,475	53,23

¹ Revised figures.**SECONDARY LEAD**

Although some scrap lead is treated at primary smelters and refineries, the greater part is received at a large number of plants that treat secondary materials exclusively. Secondary lead is recovered in the form of refined lead, antimonial lead, and other alloys. Recovery at primary and other plants in 1943 and 1944 is shown in the following table. Secondary lead recovered in 1944 was 3 percent less than in 1943 and was equivalent to 71 percent of the total refined primary lead produced in the United States. Further details appear in the chapter on Secondary Metals—Nonferrous.

Secondary lead recovered in the United States, 1943-44, in short tons

	1943 ¹	1944
As refined metal:		
At primary plants.....	1,863	11,368
At other plants.....	56,459	43,678
	58,322	55,046
In antimonial lead:		
At primary plants.....	32,887	34,475
At other plants.....	144,040	146,343
	176,927	180,818
In other alloys.....	106,845	95,552
Grand total:		
Short tons.....	342,094	331,416
Value.....	\$43,788,000	\$42,421,100

¹ Revised figures.**LEAD PIGMENTS**

The principal lead pigments are litharge, white lead, red lead, sublimed lead, leaded zinc oxide, and orange mineral. These products are manufactured for the most part from lead ore and metal. Details of the production of lead pigments and salts are given in the chapter on Lead and Zinc Pigments and Zinc Salts.

MINE PRODUCTION

The mine production of recoverable lead (including that made into lead pigments) in the United States and Alaska decreased 8 percent in 1944 and was 16 percent under the war-period peak reached in 1942. Of the 23 States and Alaska where lead is commonly produced, 14 States and Alaska showed a decline in output, 7 States recorded a

and remained the same, and 1 showed no production for the second consecutive year. The reason for the decline in production was nearly a critical shortage of manpower.

Production of recoverable lead in the United States, 1925-29 (average) and 1940-44, by States, in short tons

State	1925-29 (average)	1940	1941	1942	1943	1944
United States and Alaska:						
Alabama	982	779	662	415	200	44
Arizona	9,743	13,266	15,638	14,772	13,727	16,707
California	2,070	1,772	3,464	5,151	5,820	5,682
Colorado	30,112	11,476	12,574	15,181	18,032	17,698
Idaho	141,610	104,834	104,914	113,909	96,457	83,530
Illinois	18,871	23,036	21,259	20,050	16,324	13,105
Indiana	9,807	7,499	9,623	5,376	4,790	6,605
Iowa	6,730	3,822	4,668	4,608	5,723	7,265
Kansas	6	35	59	23	4	4
Michigan	21	7	—	85	41	34
Minnesota	213	205	186	181	13	—
Missouri	149,509	75,688	69,601	71,930	65,257	52,519
Montana	1,323	2,555	3,903	4,861	5,022	5,825
Nebraska	—	—	—	3	—	—
Total	370,997	244,974	246,551	256,535	231,410	209,018
United States:						
Alabama	38	55	11	2	1	—
Arizona	552	1,508	2,376	2,344	2,043	1,971
California	26,121	11,927	14,538	9,419	9,213	9,394
Colorado	135	360	282	335	240	170
Idaho	202,240	172,052	165,909	199,548	184,910	174,683
Illinois	58,306	21,240	25,021	22,806	19,733	13,944
Indiana	1,745	445	1,225	775	920	1,415
Total	289,137	207,587	209,362	235,229	217,060	201,577
Foreign States:						
New York	—	1,973	2,100	2,434	2,355	1,644
Denmark	250	573	23	238	200	—
France	3,846	2,285	3,390	1,803	2,288	4,622
Total	4,096	4,831	5,513	4,475	4,843	6,266
Total	664,230	457,392	461,426	496,239	453,313	416,861

Lead mining is centered largely in three areas—Southeastern Missouri; the Tri-State area (Joplin region), embracing Southwestern Missouri, Southeastern Kansas, and Northwestern Oklahoma; and the Western States (principally Idaho, Utah, Colorado, Arizona, and Montana). Of the total produced in the United States, the greater part is supplied from a relatively small number of large mines. The Southeastern Missouri district continued to be the largest lead-producing area, supplying 41 percent of the total domestic output despite a 5-percent decline from 1943. The greater part of the production from this district, as in the past, came from four mines of the J. Joseph Lead Co. The Tri-State area—principal zinc-producing district in the United States—supplied 7 percent of the total United States lead output compared with 8 percent in 1943. The largest producer in the region was the Eagle-Picher Mining & Smelting Co. The Western States contributed 50 percent of the total domestic production in 1944, Idaho being the largest producer of the group and second-largest in the United States, notwithstanding a production decline of 13 percent. Ten properties in Idaho produced three-quarters of the State total lead output, and of the total the greater part was from zinc-lead ore and old tailings, the remainder being

principally from lead ore. Utah again ranked second among the Western States and third in the United States, although the output of 52,519 tons of recoverable lead was 20 percent less than in 1943 and the lowest production since 1921. The United States & Louisiana property in the Bingham district, operated by the United States Smelting, Refining & Mining Co., was by far the largest lead producer in the State. In Arizona, four mines furnished two-thirds of the State total lead output which advanced 22 percent above that of 1943. One-half of the production from Colorado and Montana came from three mines in each of these States. Additional details on production by mines and districts can be found in the State chapters.

Mine production of recoverable lead in the United States, by districts that produced 1,000 tons or more during any year, 1940-44, in short tons

District	State	1940	1941	1942	1943	1944
Southeastern Missouri region	Missouri	169,893	164,342	197,291	179,012	169,271
Coeur d'Alene region	Idaho	95,609	95,529	106,474	89,813	76,8
West Mountain (Bingham)	Utah	37,857	34,512	39,996	35,437	31,1
Joplin region	Kansas, Southwestern Missouri, Oklahoma	35,311	41,080	34,341	34,722	28,0
Park City region	Utah	19,749	19,094	15,278	16,022	11,6
Leadville	Colorado	794	1,112	3,348	4,950	5,71
Tintic	Utah	6,536	9,424	10,176	8,261	5,31
Metaline	Washington	2,495	3,819	4,553	4,581	5,27
Central	New Mexico	3,245	3,902	3,026	3,571	4,42
Austinville	Virginia	2,285	3,390	1,661	3,740	4,23
Old Hat	Arizona	1,908	2,172	1,801	3,140	4,16
Pioche	Nevada	5,520	6,822	2,764	2,942	4,05
Warren	Arizona	692	970	813	712	3,49
Warm Springs	Idaho	5,050	5,334	3,783	3,635	3,33
Summit Valley (Butte)	Montana	8,859	8,630	7,206	3,290	3,25
Rush Valley	Utah	4,760	4,168	3,988	3,505	2,90
Pioneer (Rico)	Colorado	1,928	2,525	2,282	2,566	2,82
Coso	California	40	700	755	2,448	2,60
Pima (Sierritas, Papago, Twin Buttes)	Arizona	6	4	11	578	2,44
Heddleston	Montana	50	967	2,290	2,350	2,43
Animas	Colorado	2,471	3,045	2,124	2,657	2,23
Harshaw	Arizona	4,581	5,541	6,132	3,496	2,21
Bayhorse	Idaho	935	1,378	1,644	1,481	2,07
Kentucky—Southern Illinois	Kentucky, Southern Illinois	1,860	2,538	2,546	2,199	2,04
Resting Springs	California	870	2,581	4,044	2,938	1,90
St. Lawrence County	New York	1,973	2,100	2,434	2,355	1,64
Magdalena	New Mexico	65	424	864	1,320	1,62
Upper Mississippi Valley	Iowa, Northern Illinois, Wisconsin	453	1,345	908	1,004	1,50
Red Cliff	Colorado	1,412	1,710	2,240	1,761	1,44
Upper San Miguel	do	1,278	1,408	1,716	2,074	1,44
Smelter (Lewis and Clark County)	Montana	1,363	1,527	1,988	2,389	1,36
Big Bug	Arizona	690	594	953	1,145	1,24
Eagle	Montana	4,108	3,294	1,999	1,580	1,12
Wallapai	Arizona	2,304	2,408	1,656	1,392	784
Montana	Montana	955	1,601	1,025	509	569
Ophir	Utah	5,354	1,437	1,623	1,461	365
Cataract	Montana	1,904	355	26	115	59
Barker	do	131	22	1,712	1,633	56
Port Hill	Idaho	1,837	1,537	1,044	316	15
Hog Heaven	Montana	3,588	2,824	614	-----	1

¹ Total for Virginia, but almost entirely from Austinvillle district.

STOCKS

Producers' stocks.—Lead stocks, as reported by the American Bureau of Metal Statistics, are shown in the following table. Stocks of refined and antimonial lead include metal held by all primary refiners and by some of the refiners of secondary material who produce soft

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1943	1944
9,012	160,222
9,813	78,812
15,437	31,169
14,722	26,089
16,022	11,686
4,950	5,732
8,261	5,319
4,581	5,775
3,571	4,428
1,760	4,235
1,140	4,161
1,942	4,036
712	3,087
3,635	3,335
3,290	3,251
3,505	2,301
1,566	2,236
448	2,170
578	2,145
2,350	2,436
2,657	2,226
3,496	2,212
1,481	2,071
1,199	2,048
1,438	1,400
2,355	1,644
1,630	1,639
1,004	1,508
1,761	1,444
2,074	1,462
2,389	1,364
1,145	1,344
1,540	1,125
1,892	994
1,609	365
1,461	89
115	26
643	15
316	1

American
Stocks
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and plus foreign lead smelted and refined in the United States and used for domestic consumption. According to the monthly reports released by the American Bureau of Metal Statistics, combined stocks of refined lead and antimonial lead fluctuated during the first months of 1944, but for the remainder of the year the trend was upward. From 27,996 tons on hand at the end of November 1943, stocks advanced to a year-end total of 33,090 tons and continued to increase to 37,590 tons on January 31. This was followed by a drop to 34,379 tons by the end of March, with a subsequent sharp rise to 39,430 tons on May 1, the highest point reached in 1944. Throughout the remainder of 1944 stocks steadily declined—with the exception of a minor increase at the end of November—the year-end total was 29,536 tons, a net decrease of 41 percent from the beginning of 1944.

Stocks at end of year at smelters and refineries in the United States, 1940-44, in short tons

	1940	1941	1942	1943	1944
Domestic lead.....	32,458	15,973	28,815	28,821	15,602
Antimonial lead.....	8,408	4,212	6,122	4,269	3,934
Total.....	40,926	20,185	34,937	33,090	19,536
Base bullion—					
At smelters and refineries.....	9,166	8,594	7,359	8,640	7,333
In transit to refineries.....	3,457	2,215	1,706	3,112	3,331
In process at refineries.....	18,141	17,709	13,925	16,020	14,473
Total.....	30,764	28,518	22,990	27,772	25,137
Ore and matte and in process at smelters.....	71,722	51,446	59,247	68,678	80,461
Total.....	143,412	100,149	117,174	129,540	125,134

The results of the Bureau of Mines annual survey of primary lead smelters and refineries showed stocks of 36,464 tons of refined lead at plants on January 1, 1944, and 16,788 tons on December 31, 1944. In these same plants antimonial lead stocks decreased from 3,682 short tons (lead content) at the beginning to 3,387 tons at the end of 1944. In terms of lead content, stocks of ore at 17 operating smelters and refineries (including 1 small plant not canvassed in 1943) increased 16 percent from 50,935 tons to 60,480 during the same period. The inventory of base bullion at refineries that receive base bullion as a raw material and at smelters that produce base bullion for shipment to refineries totaled 8,110 tons at the beginning of January and 6,606 tons at the end of December 1944. Stocks of "in process" base bullion or work lead at 5 combination smelter-refinery plants are not included in reports to the Bureau of Mines. No direct comparison can be made between these data and the figures of the American Bureau of Metal Statistics. Figures reported to the Bureau of Mines represent physical inventory at the plants, irrespective of ownership, and do not include material in process or in transit.

Consumers' stocks.—According to reports from 570 consumers' plants 89,743 tons of domestic and foreign refined lead were in stock on December 31, 1944, a 22-percent decline from the 115,152-ton inventory on hand at the end of 1943.

Consumers' stocks of refined soft lead at the end of 1943 and 1944, by grades, short tons

	Domestic and foreign					Foreign (all grades)
	Corrod- ing	Chem- ical	Com- mon	Other	Total	
Dec. 31, 1943 ¹	25,891	18,892	65,921	4,448	115,152	13.2
Dec. 31, 1944	28,789	13,690	44,425	2,839	89,743	10.5

¹ Revised figures.

Government stocks.—In addition to industry-owned stocks, a sizable though diminishing supply of Government-owned lead was held at various depots throughout the United States for release through allocation to consumers as needed. According to reports submitted to the Tin-Lead-Zinc Division of the War Production Board, Government stocks totaled 90,454 tons of refined lead on December 31, 1944, compared with 173,875 tons of refined lead on January 1, 1944.

DOMESTIC CONSUMPTION

A survey of 570 plants in 1944 (530 (corrected figure) in 1943) representing an estimated 90 percent of the consumers of refined lead showed a total consumption of 722,820 short tons of refined lead, a gain of 7 percent over 1943. Some secondary as well as primary refined lead is included in this figure. Antimonial lead, unrefined scrap lead, and lead in alloys are excluded. The additional number of plants covered in the 1944 survey include for the most part small consumers that did not report in previous years. The lead consumed by these plants was small in relation to the total and does not measurably affect the trends indicated by comparison with the 1943 data.

Of the total consumed, 22 percent was used to make red lead and litharge, 15 percent for cable covering, 11 percent for tetraethyl, 10 percent for storage batteries, 4 percent for sheet lead, 4 percent for ammunition, and the remaining 34 percent for a variety of products and uses shown in the accompanying table.

Consumption of refined lead in the United States, 1941-44, by uses, in short tons

	1941	1942	1943	1944
Ammunition	32,959	48,025	64,023	31,479
Bearing metals	10,160	8,466	10,189	15,941
Brass and bronze	(1)	5,294	5,748	7,845
Cable covering	141,161	128,535	117,802	110,417
Calking lead	32,380	9,047	8,618	9,411
Casting metals	9,243	3,106	3,072	4,425
Collapsible tubes	3,726	9,966	11,425	12,482
Foil	51,516	9,359	5,816	11,190
Pipe, traps, and bends	32,946	21,411	18,724	24,387
Sheet lead	35,480	31,700	27,738	31,546
Solder	35,630	13,371	15,472	22,390
Storage batteries	73,982	62,604	68,239	68,769
Terne plate	2,069	2,336	815	2,190
Type metals	2,975	943	812	1,269
White lead	83,230	56,476	36,809	54,333
Red lead and litharge	143,496	100,563	124,715	157,080
Tetraethyl lead	48,327	50,152	65,320	83,067
Chemicals and insecticides	8,861	6,298	8,172	10,703
Annealing	(1)	5,229	5,987	5,719
Galvanizing	(1)	484	819	1,073
Lead plating	(1)	(1)	941	494
Weights and ballast	(1)	(1)	9,260	22,964
Other	64,506	33,746	64,940	33,646
Total	812,647	607,111	675,465	722,820

¹ Included under "Other."

Distribution of the total consumed by related uses shows 51 percent consumed for metallic products, 31 percent for pigments, 13 percent in chemicals, and 5 percent in miscellaneous uses such as painting, galvanizing, lead plating, and weights and ballast.

Reports to the Tin-Lead-Zinc Division of the War Production Board indicate that the consumption of primary, antimonial, and secondary lead totaled 1,119,000 tons in 1944 compared with 1,113,000 tons in 1943.

The following table shows the calculated apparent shipments of refined primary lead to domestic consumers. The apparent shipments of 775,095 tons in 1944 are probably more nearly correct than the actual receipts of 697,411 tons reported by consumers, because of complete coverage of the survey.

Apparent shipments of refined primary pig lead to domestic consumers, 1940-44, in short tons

	1940	1941	1942	1943	1944
Stocks at primary refineries on Jan. 1.....	(1)	(1)	² 12,000	39,255	36,464
Stocks at primary refineries on Dec. 31.....	(1)	(1)	17,934	248,361	173,875
Production.....	533,179	570,967	566,839	⁴ 469,612	464,763
Exports.....	149,889	274,189	366,497	244,033	222,758
Total available.....	683,068	845,156	969,270	⁴ 1,001,261	897,860
Stocks at primary refineries on Dec. 31.....	(1)	(1)	39,255	36,464	16,788
Stocks at primary refineries on Jan. 1.....	(1)	(1)	17,934	173,875	90,454
Exports.....	⁴ 49,079	14,359	⁶ 5,814	⁶ 13,261	15,523
Total withdrawn.....	49,079	32,293	293,430	223,600	122,765
Apparent shipments to domestic consumers.....	633,989	812,863	669,840	⁴ 777,661	775,095

¹ Figures not available.

² Figures based upon American Bureau of Metal Statistics data.

³ Figures based upon reports submitted to the Tin-Lead-Zinc Division of the War Production Board.

⁴ Figures not available.

⁵ Figures based upon reports submitted to the Tin-Lead-Zinc Division of the War Production Board.

⁶ Figures based upon reports submitted to the Tin-Lead-Zinc Division of the War Production Board.

PRICES

The two major markets for lead in the United States are New York and St. Louis; much of the lead produced in this country is sold at prices normally based upon quotations in these markets. Since suspension of the London Metal Exchange dealings in September 1939 the London market has had no direct influence on New York quotations, and the differential between St. Louis and New York prices has remained at 0.15 cent a pound, an amount approximating the freight charges between the two points.

The ceiling price for common lead—6.35 cents a pound, St. Louis, and 6.50 cents, New York—remained unchanged throughout 1944. For comparison it is of interest to note that the average price received by the primary producers for all grades of refined lead (excluding antimonial lead) sold in 1944 was 6.4 cents a pound, f. o. b. plant, the same as in 1943. The 1944 price of 8.0 cents for lead, which appears in the separate State chapters, represents the above weighted average price received for refined lead plus the increment—in terms of cents per pound based upon the total domestic mine output of recoverable lead—of \$13,745,815 in overquota premiums and special mine contracts paid by the Metals Reserve Company.

The Premium Price Plan, whereby producers (miners) of lead (copper and zinc were also included in the plan) receive increments above the ceiling price (through Metals Reserve Company) for over quota production, was maintained throughout 1944. As the plan operative only until July 31, 1945, Congress passed the Hayden-McFarland bill, S. 502, on June 14, 1945, to extend the time limit to June 30, 1946. More complete details of the scope of the Premium Price Plan—which was effective February 1, 1942—can be found in the chapter on Lead in Minerals Yearbooks for 1942 and 1943. In May 1945 the Office of Price Administration released a comprehensive compilation of data showing production of copper, lead, and zinc under the Premium Price Plan since February 1942, at the various quota levels and the payments made. The salient statistics from this report with reference to lead, are given in the following table.

Salient statistics on lead with regard to the operation of the Premium Price Plan 1942-44

	1942 ¹		1943		1944	
	Tri-State district	United States exclusive of Tri-State	Tri-State district	United States exclusive of Tri-State	Tri-State district	United States exclusive of Tri-State
Total production of recoverable lead ²						
short tons.....	30,746	416,310	34,830	409,170	28,956	381,060
Ceiling production at 6.50 cents a pound.....do.....	10,811	358,447	1,863	294,001	3,138	200,619
Percent of ceiling production to total production.....percent.....	35.16	86.10	5.35	71.85	10.84	52.65
Production under Premium Price Plan:						
"A" quota (9.25 cents a pound) short tons.....do.....	19,700	56,321	26,259	83,023	19,494	142,925
"B" quota (12.00 cents a pound).....do.....	235	1,542	6,514	32,146	5,633	37,516
Total premium production.....do.....	19,935	57,863	32,773	115,169	25,127	180,441
Metals Reserve Company mine contracts.....do.....			194		691	
Total overceiling production.....do.....	19,935	57,863	32,967	115,169	25,818	180,441
Percentage of overceiling production to total:						
Production under Premium Price Plan:						
"A" quota.....percent.....	64.07	13.53	75.39	20.29	67.32	37.51
"B" quota.....percent.....	0.77	0.37	18.70	7.86	19.45	9.84
Total premium production.....do.....	64.84	13.90	94.09	28.15	86.77	47.35
Metals Reserve Company mine contracts.....percent.....			0.56		2.39	
Total overceiling production.....do.....	64.84	13.90	94.65	28.15	89.16	47.35
Payments under Premium Price Plan: ³						
"A" quota.....dollars.....	1,096,435	3,182,450	1,802,497	6,334,273	1,381,983	9,924,261
"B" quota.....dollars.....	12,910	84,789	358,279	1,768,050	309,813	2,063,364
Total premium production.....do.....	1,109,345	3,267,239	2,160,776	8,102,323	1,691,796	11,987,625
Metals Reserve Company mine contracts ⁴ dollars.....			16,127		66,394	
Total overceiling payments.....do.....	1,109,345	3,267,239	2,176,903	8,102,323	1,758,190	11,987,625
Average prices per pound of lead: ⁴						
Average premium production.....cents.....	9.282	9.323	9.797	10.018	9.866	9.822
Metals Reserve Company mine contracts.....cents.....			10.651		11.307	
Total overceiling production.....do.....	9.282	9.323	9.802	10.018	9.905	9.822
Total production.....do.....	8.304	6.892	9.625	7.490	9.536	8.073

¹ Premium Price Plan effective Feb. 1, 1942; data refer to February-December, inclusive.

² Production of Tri-State lead from Metals Reserve Company agency, Joplin, Mo., all other from Bureau of Mines monthly reports. These data are preliminary and do not exactly equal final annual totals for the United States.

³ Data on premium payments and Metals Reserve Company mine contract payments from Metals Reserve Company. All payments shown are subject to correction due to additional payments as a result of retroactive quota adjustments, late reports by smelters and custom mills, etc.

⁴ All average prices shown include Office of Price Administration ceiling price of 6.50 cents a pound for lead.

The official London maximum price of £25 per long ton, duty paid, Empire and foreign lead, remained unchanged during 1944.

Monthly and yearly quoted prices of lead at St. Louis, New York, and London, 1942-44, in cents per pound¹

Month	1942			1943			1944		
	St. Louis	New York	London	St. Louis	New York	London	St. Louis	New York	London
Jan.	6.12	6.27		6.35	6.50		6.35	6.50	
Feb.	6.35	6.50		6.35	6.50		6.35	6.50	
Mar.	6.35	6.50		6.35	6.50		6.35	6.50	
Apr.	6.35	6.50		6.35	6.50		6.35	6.50	
May	6.35	6.50		6.35	6.50		6.35	6.50	
Jun.	6.35	6.50		6.35	6.50		6.35	6.50	
Jul.	6.35	6.50	(?)	6.35	6.50	(?)	6.35	6.50	(?)
Aug.	6.35	6.50		6.35	6.50		6.35	6.50	
Sep.	6.35	6.50		6.35	6.50		6.35	6.50	
Oct.	6.35	6.50		6.35	6.50		6.35	6.50	
Nov.	6.35	6.50		6.35	6.50		6.35	6.50	
Dec.	6.35	6.50		6.35	6.50		6.35	6.50	
Average	6.33	6.48	(?)	6.35	6.50	(?)	6.35	6.50	(?)

¹ *St. Louis: Metal Statistics, 1944, p. 477. New York: Metal Statistics, 1944, p. 471.*

² *London Metal Exchange dealings suspended for duration of war. Official maximum price fixed by the Ministry of Supply at £25 in December 1939.*

FOREIGN TRADE²

Imports.—During 1944 imports of lead continued at a high rate—nearly the same as in 1943—but considerably below the record total of 1942. The greater part of the total pig lead imported came from Mexico, as usual, but a substantial tonnage was from Peru. The marked drop in the quantity from Mexico reflects the lower production of that country due to the strike against mining and smelting companies from June 8 to August 11 and to the extremely poor condition of the railroads and rolling stock, which hampered transportation of lead from the mines to the smelters. Receipts of lead in ore and matte, which constituted 30 percent of the total in all forms, were 35 percent higher than in 1943 owing largely to a marked increase in imports from Australia, Newfoundland, and Peru which more than offset a substantial decline from Africa and Bolivia. Imports of lead in base metal dropped to only a few tons, owing to a complete absence of receipts of this material from Australia. Four countries furnished 93 percent of the total lead in all forms imported into the United States in 1944: Mexico 53 percent, Peru 20, Newfoundland 10, and Australia 10, compared with 68, 7, 4, and 10 percent, respectively, for a total of 89 percent in 1943.

¹ *Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Commerce.*

*Total lead imported into the United States in ore, matte, base bullion, pigs, and reclaimed, 1940-44, by countries, in short tons*¹

Country	1940	1941	1942	1943	1944
In ore and matte:					
Africa.....	7,586	575	3,879	16,438	
Argentina.....	16,469	13,374	4,582		
Australia.....	17,472	22,634	20,997	19,743	2
Bolivia.....	2,707	7,314	1,382	7,012	
Canada.....	8,666	5,725	7,487	6,828	1
Chile.....	6,271	1,384	3,166		
Mexico.....	1,804	5,770	2,358	2,931	
Newfoundland.....	27,563	17,569	23,951	13,473	3
Peru.....	18,383	6,665	11,168	3,426	11
United Kingdom ²	3,498	175			
Other countries.....	881	930	392	172	
	111,300	82,115	79,362	70,023	95
In base bullion:					
Australia.....		835	42,900	3,846	
Mexico.....	19,009	23,726	56	639	
Peru.....	179	58	16	94	
Other countries.....	436	85	883	4	
	19,624	24,704	43,855	4,583	
In pigs and bars:					
Australia.....	4,266	43,631	83,352	8,994	
Canada.....	50	89,835	69,210	16	
Mexico.....	128,680	99,950	192,044	214,865	167
Peru.....	18,452	40,773	21,891	20,158	54
Other countries.....	100				
	151,548	274,189	366,497	244,033	222
In reclaimed, scrap, etc.:					
Australia.....			1,396		2
Canada.....	4	52	1,292	348	
Panama, Republic of.....	1	4	5	128	
Peru.....		95	57		
Other countries.....	15	55	7	1	
	20	206	2,757	477	3
	282,492	381,214	492,471	319,116	321

¹ Data include lead imported for immediate consumption plus material entering the country under bond.

² United Kingdom of Great Britain and Northern Ireland.

Lead¹ imported for consumption in the United States, 1940-44, by forms in which imported

Year	Lead in ores, flue dust, and mattes n. s. p. f.		Lead in base bullion		Pigs and bars		Sheets, pipe, and shot		Not otherwise specified (value)	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1940.....	70,027	\$4,659,445	9,992	\$929,946	36,882	\$2,269,075	201	\$36,444	\$12,046	\$7,910,873
1941.....	82,345	5,343,577	17,579	1,743,350	325,999	23,403,260	47	15,812	19,389	30,582,741
1942.....	87,377	5,715,251	48,589	4,285,425	387,693	32,328,330	20	7,009	4,690	42,478,098
1943.....	83,153	5,590,218	4,511	557,545	244,033	20,903,382	25	20,208	5,219	27,132,730
1944.....	100,723	6,741,418	262	29,346	223,379	22,793,430	40	39,572	547	29,902,771

¹ In addition to quantities shown (values included in total values), "reclaimed, scrap, etc.," imported as follows—1940: 24 tons, \$3,917; 1941: 1,331 tons, \$57,353; 1942: 1,305 tons, \$137,393; 1943: 496 tons, \$56,158; 1944: 3,313 tons, \$298,458. Figures for 1942, 1943, and 1944 include foreign lead received by the Government and held in stock piles.

products, containing lead, imported for consumption in the United States, 1940-44

Year	Babbitt metal, solder, white metal, and other combinations containing lead			Type metal and antimonial lead		
	Gross weight (short tons)	Lead content (short tons)	Value	Gross weight (short tons)	Lead content (short tons)	Value
1940	1,368	429	\$1,026,432	1,482	1,291	\$108,288
1941	702	241	711,388	1,657	1,454	112,120
1942	971	274	66,096	245	210	19,631
1943	236	69	330,824	3,703	3,422	447,019
1944	26	18	12,706	7,562	7,174	954,255

Under the restrictions of the Export Control Act of 1940, exports of pig lead in 1944 continued to be relatively small. Of the tons exported, 92 percent went to the Union of Soviet Socialist Republics. Reexports of foreign refined lead were negligible in 1944, amounting to less than 1 ton.

Lead exported from the United States, 1940-44

Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back	Year	Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back
Short tons	Value			Short tons	Value	
1940	23,755	\$1,794,590	1943	2,003	\$244,433	Short tons (1)
1941	14,359	1,159,148	1944	15,523	2,073,145	(1)
1942	1,940	285,354				

Not available.

Lead exported from the United States, 1940-44, by destinations, in short tons

Destination	1940 ¹	1941	1942 ²	1943 ²	1944 ²
United States	1,559	764	51	779	- 450
Canada	492	822	18	7	23
Mexico	517	2,335			1
Central America	188	196	5	51	34
Caribbean	279	97	4	26	18
South America	112				
Europe	1,120				
Asia	437				
Australia	11,958	8,154			
Oceania	336				
Islands	2,352				
Philippine Islands	538	379	74	8	18
Other Islands	450	628			
Other Asia	638	114			542
Other Oceania	301	112	224		
Other Europe			6	14	14,314
Other Kingdoms	2		1,379	1,017	
Other Asia	350	407			7
Other Oceania	244	25	20	8	17
Other countries	1,882	326	159	93	99
	23,755	14,359	1,940	2,003	15,523
North America	865	574	135	80	80
South America	3,078	2,334	190	883	541
Europe	6,400	228	1,609	1,031	14,867
Asia	13,384	11,132	4	6	30
Africa and Oceania	28	91	2	3	5

¹ Includes 25,324 tons of foreign lead were reexported, according to American Bureau of Metal Statistics; figures not available.

² Includes 3,574 tons of foreign lead were reexported in 1942, 11,258 tons in 1943, and less than 1 ton in 1944.

³ United Kingdom of Great Britain and Northern Ireland.

WORLD ASPECTS OF THE LEAD INDUSTRY

The rapid succession of events in 1944 and early 1945, culminating in the unconditional surrender of Germany in May 1945, opened door to revealing greater detail regarding the lead industry in foreign countries than had been available since 1939. Censorship restrictions—imposed for reasons of security—have been removed by the governments of most of the lead-producing countries, and unrestricted information regarding European countries formerly under Axis control is beginning to flow by way of official channels. Nevertheless, it is not yet possible to present a complete picture of world production and consumption of lead during the years of the European phase of the war. The lead position of the United Nations was satisfactory in 1944, and, although consumption probably did grow somewhat, this increase was accomplished at the expense of accumulated stocks owing to an indicated over-all decline in production.

World production of lead, 1933-44, in metric tons¹

[Compiled by B. B. Waldbauer]

Country	1938	1939	1940	1941	1942	1943	1944
Argentina.....	10,200	14,000	12,864	18,021	20,760	23,800	19,000
Australia.....	226,155	269,590	275,000	(2)	(2)	(2)	(2)
Belgium.....	94,170	82,000	55,000	20,000	(2)	(2)	(2)
Burma.....	80,166	77,220	83,000	(2)	(2)	(2)	(2)
Canada.....	181,783	172,880	199,662	201,976	220,726	203,656	130,000
China.....	2,000	(2)	(2)	(2)	1,315	1,179	(2)
Chosen.....	10,000	(2)	(2)	(2)	(2)	(2)	(2)
Czechoslovakia.....	5,000	(2)	(2)	(2)	(2)	(2)	(2)
France.....	41,753	42,000	20,000	10,000	(2)	13,724	4,000
Germany.....	171,700	181,400	200,000	225,000	(2)	(2)	(2)
Austria.....	9,280	(2)	(2)	(2)	(2)	(2)	(2)
Greece.....	6,050	4,925	(2)	(2)	(2)	(2)	(2)
Hungary.....	150	(2)	(2)	(2)	(2)	(2)	(2)
Indochina.....	10	5	(2)	(2)	(2)	(2)	(2)
Italy.....	43,287	38,102	35,000	(2)	(2)	(2)	(2)
Japan.....	12,000	12,000	15,000	17,000	(2)	(2)	(2)
Mexico.....	273,529	213,675	191,980	151,167	192,989	212,452	178,200
Northern Rhodesia.....	277	163	293	378	(2)	(2)	(2)
Norway.....	323	321	(2)	(2)	(2)	(2)	(2)
Peru.....	28,478	24,310	31,131	32,871	37,915	43,171	38,900
Poland.....	19,973	(2)	25,000	25,000	(2)	(2)	(2)
Rumania.....	5,655	5,100	(2)	(2)	(2)	(2)	(2)
South-West Africa.....	3,214	4,283	690	(2)	(2)	(2)	(2)
Spain.....	31,809	25,991	45,991	46,865	41,149	36,760	34,770
Tunisia.....	23,916	23,421	(2)	(2)	(2)	(2)	(2)
Union of South Africa.....	19	11	(2)	(2)	(2)	(2)	(2)
U. S. S. R.....	68,490	74,800	75,000	(2)	100,000	125,700	(2)
United Kingdom.....	10,000	(2)	(2)	(2)	(2)	(2)	(2)
United States (refined) ²	330,963	404,257	468,675	494,126	497,908	425,903	421,530
Yugoslavia.....	8,646	10,652	(2)	(2)	(2)	(2)	(2)
	1,700,000	1,734,000	(2)	(2)	(2)	(2)	(2)

¹ By countries where smelted, but not necessarily refined.² Data not yet available; estimate included in total in 1939.³ Approximate production.⁴ Unoccupied China.⁵ Exclusive of secondary material (Metallgesellschaft, Frankfurt on the Main).⁶ Includes small tonnage of lead contained in exported ore and concentrates. Separate figures not available.⁷ Figures cover lead refined from domestic and foreign ores; refined lead produced from foreign base bullion not included.

REVIEW BY COUNTRIES

Argentina.—The Aguilar mine of the Compañía Minera Aguilar, S. A., subsidiary of the St. Joseph Lead Co., continued to be the leading producer in 1944. Lead concentrates totaling 37,887 metric tons, containing 75 percent lead, were produced in Argentina in 1944, of which approximately 35,000 tons were from Aguilar.

India.—A shortage of manpower continued to plague the mining industry during 1944. A reduction of about 50,000 long tons in the amount of ore treated by the Zinc Corp., Ltd.—due to shortage of labor—was counter-balanced to some extent by an improvement in the grade. Although normal exploration and development have been continued to meet production requirements, the ore reserves have declined to roughly 4,000,000 tons, averaging 11.5 percent zinc and 11 percent lead. The problem of supplying enough water has become much concern. The lead content of concentrate produced in 1944 was reported to total 75,834 short tons as against 79,016 tons in 1943.

Isa Mines, Ltd., is reported to have 8,000,000 long tons of zinc ore in reserve averaging 8.6 percent lead and 8 percent zinc. This total excludes a much larger tonnage of material containing as little as 4 percent lead, which is not considered ore under existing conditions.

Production data are being released by the Australian authorities, but official figures had not been received at the time of writing (June 1944). Data from an unofficial source indicate that total mine production of lead in Australia was 197,300 short tons in 1944 (211,600 short tons in 1943).

Bolivia.—Mine production of lead in Bolivia decreased from 11,387 metric tons (lead content) in 1943 to 9,047 tons in 1944. All ores and concentrates are exported, some going to Argentina for smelting and some to the United States. Again, as in 1943, exports declined because of an increase in prices of materials, cost of labor, and the difficulty of transporting ores from the country. The Matilde mine at Lake Titicaca, owned by Compañía Hochschild, was reported to have as of 1944—some 4,000,000 metric tons of ore in reserve containing an average of 18.7 percent zinc and 2.5 percent lead, 0.7 percent copper, and 1.75 ounces of silver per ton.

Brazil.—A new lead smelter was built in 1944 by Plumbum, S. A., at Pampas, State of Paraná. The plant is reported to include a No. 4 sintering hearth, a No. 4 Mace blast furnace, and a Parkes converter refinery with a capacity of 20 metric tons of refined lead daily. This smelter is the second to be constructed in Brazil, the first being the Apiai smelter at Apiai built and operated by the São Paulo Government. The Apiai plant, which had a daily capacity of 10 tons of refined lead, shut down in October 1942 and has not operated since, although a new refinery is reported under construction.

Burma.—The famous Bawdwin lead-zinc mine and smelter—which before the war produced 80,000 tons of lead a year—was reported captured from the Japanese early in 1945. Not long before recovery of the mine the property was bombed by the Allies. As the ore reserves last reported before the war indicated a relatively short life owing to this centuries-old mine, doubts have been expressed as to the mine opening if damage is found to be severe.

Canada.—Mine production of lead in Canada decreased from 229,930 short tons (revised) in 1943 to 151,611 tons (preliminary) in 1944. The output of refined lead in 1944 was 143,757 tons (preliminary) compared with 224,493 tons in 1943. Over 90 percent of Canada's production of lead was from the Sullivan mine of the Consolidated Mining & Smelting Co., which operates the only Canadian lead smelter and electrolytic lead refinery. The plant is at Trail, British Columbia.

In 1943 a 250-ton mill was reportedly to be built at the Sherbrooke, Quebec, property of the Aldermac Mining Corp. Production was begun at the completed mill in July 1944, on ore averaging 7 percent zinc, 2.5 percent copper, 2 percent lead, and containing some gold and silver.

In July 1944 the Department of Munitions and Supply announced suspension of operations at four high-cost lead-zinc properties which had been producing for the Metals Reserve Company, an agency of the United States Government. The labor and materials formerly utilized at these properties, the Twin "J" mines, Duncan, British Columbia, Kootenay-Florence mine, Ainsworth, British Columbia, Lake Geneva mine at Benny Siding, Ontario, and Tetreault mine, Notre Dame des Anges, Quebec, have been released for more urgent needs.

France.—The lead-smelting industry in France depends largely on imported ores, but in recent years new mines have been developed and the output of lead concentrates has shown an increase. Production of lead (content of lead in ores and concentrates) from 1938 through 1944, in metric tons, was as follows:

Year	1938	1939	1940	1941	1942	1943	1944
Production.....	4, 220	5, 410	2, 440	3, 870	5, 770	5, 471	3, 5

In 1943 Germany ordered France to increase mine production up to 1,000 tons a month, but the policy of the French was to reduce output when possible and divert labor for development, thereby producing less lead for export to Germany. The lead smelter at Ceilhes was taken over by Société Minière at Métallurgique de Penarroya and reopened at the end of 1944, but operation of the plant will depend upon the obtaining of imported lead concentrates and the availability of coke.

French Morocco.—Production of lead from 1940 through 1944 was as follows, in metric tons:

Year	1940	1941	1942	1943	1944
Ore and concentrates.....	30, 739	13, 918	9, 000	9, 570	13, 468
Lead content.....	22, 132	10, 020	6, 500	6, 890	9, 233

Mexico.—Production of lead in Mexico declined from 218,126 metric tons (lead content in ore) in 1943 to 185,282 tons in 1944 due to circumstances unfavorable to mining. A general labor strike against some 140 mining and smelting companies was called on June 8 and was not completely settled until August 11. The Labor Ministry announced that, with the strike settled, a general increase in mineral production at most of the properties was expected. However, severe floods in the fall of 1944 interfered with mining operations and the shipment of ore to smelters. The shortage of railway cars and generally run-down condition of the railway system further complicated an already critical situation.

Newfoundland.—The mine production, in terms of lead content of all concentrates produced, amounted to 29,661 short tons in 1944

and with 32,940 tons in 1943. The bulk of the exports of concentrates continued to go to the United States.

Peru.—The lead content of concentrates produced in Peru during 1944 is estimated to be 52,501 metric tons compared with 47,810 tons in 1943. This estimate is based upon reports of the major lead-producing companies. Exports of lead from Peru—which went to the United States—amounted to 56,747 tons of refined lead and 1,195 tons of lead contained in ore, concentrate, and other products. Comparable totals for 1943 were 20,691 tons and 5,324 tons, respectively.

The greatest part of the lead produced in Peru is derived from the gold-silver-lead-zinc ores mined by the Cerro de Pasco Corp., Department of Junin. Cia Minera Atacocha, S. A., an important producer of lead, reported the production of 58,200 tons of ore in 1944, averaging 13.5 percent lead and 14.0 percent zinc.

The Over-All Metals Agreement between the Peruvian Government and the United States Commercial Company was renewed on July 8, 1944, effective as of July 1, 1944, when the previous agreement expired. The latest agreement provides for the continued purchase by the United States Commercial Company of lead in ores and concentrates and electrolytic lead at the same price as previously furnished. The Peruvian Government was advised on December 1, 1944, that 3 months after this date lead ores and concentrates will be purchased at the rate of 10,000 metric tons a year.

The Oroyo lead smelter—which constitutes an important factor in the progress of the mining industry in the Republic—recovered 46,000 metric tons of lead in 1944 (43,171 tons in 1943). About 70 percent of the lead produced at Oroyo is derived from mines other than the Cerro de Pasco.

Spain.—Production of lead concentrates in Spain during 1944 amounted to 43,000 metric tons (47,913 tons in 1943). Refined-lead output was 32,000 metric tons compared with 34,080 tons in 1943. The drop in output was due in part to interruption of traffic with Germany. Owing to the great decline in lead production in recent years, smelter capacity is about five times current output. Unless changes are made in the internal economy of the country, Spain will continue to supply its own needs for lead, but exports will remain important.

Sweden.—The completion of a new lead smelter at Landskrona in 1944 brings to four the number of plants producing lead in Sweden, with a total capacity amounting to about two-thirds of the total prewar consumption of approximately 35,000 metric tons. The new plant uses ore obtained from mines in Central Sweden and a new mine in the northern Province of Vaesterbotten. The lead concentrates were formerly shipped to Germany. It is of interest to note that before the war lead was not smelted in Sweden.

U. S. S. R.—Official data from Russia have not been available for the past several years, but recent reports indicate that 125,700 metric tons of lead were produced in 1943.

ZINC¹

By ALFRED L. RANSOME AND ESTHER B. MILLER

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GENERAL SUMMARY

The significant feature of zinc in 1944 was that the industry, despite a most serious obstacle in the form of a critical manpower shortage met all essential demands—civilian as well as military—by a comfortable margin. Production decreased as did imports, but the overall new supply was sufficient to balance a rising consumption under relaxed Government control, with enough excess to add markedly to an already high record level of stocks. The prospect for 1945 is one of continuing insufficient supply to meet all demands, but of adequate supply for military requirements and all civilian uses other than nonessential.

Domestic mine output was 3 percent less in 1944, and smelter production of primary slab zinc from both domestic and foreign ores was lower, the total being 8 percent below the record of 1943. Year-end stocks at domestic smelters were 38 percent more than at the beginning, but consumers' inventories decreased 28 percent.

Total imports of zinc in ore and concentrates and as slab zinc decreased 18 percent. The greater part, as usual, was in the form of concentrates, largely from Mexico and Canada.

The established ceiling price of 8.25 cents a pound at St. Louis for Prime Western zinc was unchanged during 1944, and the premium-price plan for overquota mine production was maintained throughout the year.

¹ This report deals primarily with the smelting branch of the industry. Full details of zinc mining are given in the various State reports. As some zinc ore is used directly in the manufacture of zinc pigments, see chapter on Lead and Zinc Pigments and Zinc Salts.

Statistics of the zinc industry in the United States, 1925-29 (average) and 1940-44

	1925-29 (average)	1940	1941	1942	1943	1944
Primary slab zinc:						
Domestic ores..... short tons..	589,648	589,988	652,599	629,957	594,250	574,453
Foreign ores..... do.....	12,734	85,287	169,421	261,915	348,059	294,849
Total.....	602,382	675,275	822,020	891,872	942,309	869,302
Percent of total.....	21	28	27	28	35	37
Refined secondary slab zinc..... do.....	79	72	73	72	65	63
Produced at primary smelters Dec. 31..... short tons..	43,756	48,917	59,503	53,195	48,215	49,037
Available for consumption..... short tons..	45,575	19,212	24,212	82,498	168,777	233,044
Total available for consumption..... short tons..	548,472	677,168	762,265	730,938	806,252	845,008
At St. Louis:						
Domestic ores..... cents per pound..	6.76	6.34	7.48	8.25	8.25	8.25
Foreign ores..... do.....	8.90	7.25	8.25	8.25	8.25	8.25
Domestic ores..... do.....	5.40	5.50	7.25	8.25	8.25	8.25
Foreign ores at London..... do.....	6.46	(¹)	(¹)	(¹)	(¹)	(¹)
Production of recoverable zinc..... short tons..	724,720	665,068	749,125	768,025	744,196	718,642
Domestic (Joplin)..... percent of total..	49	35	35	31	27	26
Foreign..... do.....	30	36	38	40	43	46
Domestic..... do.....	21	29	27	29	30	28
Total production of zinc..... short tons..	1,435,000	1,802,000	(¹)	(¹)	(¹)	(¹)

¹ Not figure.
² Not available.

Figure 1 shows trends in the zinc industry since 1900.

WAR AGENCY REGULATIONS

During 1944 Government controls with regard to zinc were greatly relaxed. The use of zinc was liberalized by an amendment to War Production Board Conservation Order M-11-b on January 1, 1944, and on September 15 General Preference Order M-11, which relates to slab zinc, was amended to discontinue the system of allocation previously used to regulate shipments to consumers. On September 13, 1944, again on October 11, Order M-11-b was further modified, and with the exception of a list of 40 prohibited items, zinc could be shipped with no restrictions, subject, of course, to limitations imposed by existing regulations on the use of other materials needed for the manufacture of zinc-containing products. General Preference Order M-11-b, covering deliveries of zinc dust, as amended December 13, 1943, became effective January 1, 1944, and continued without change during 1944.

The premium-price plan, for overceiling payment for production of zinc in excess of quotas, was maintained throughout 1944. A brief outline of the premium-price plan and an accompanying table showing production and payments from 1942 through 1944 are given in this chapter under the heading Prices.

RECIPROCAL TRADE AGREEMENTS

Marked opposition was voiced early in 1945 against certain proposals embodied in a bill (H. R. 2652) placed before Congress to amend the Reciprocal Trade Agreements Act. The zinc industry as a whole opposed the proposed delegation of power to the President

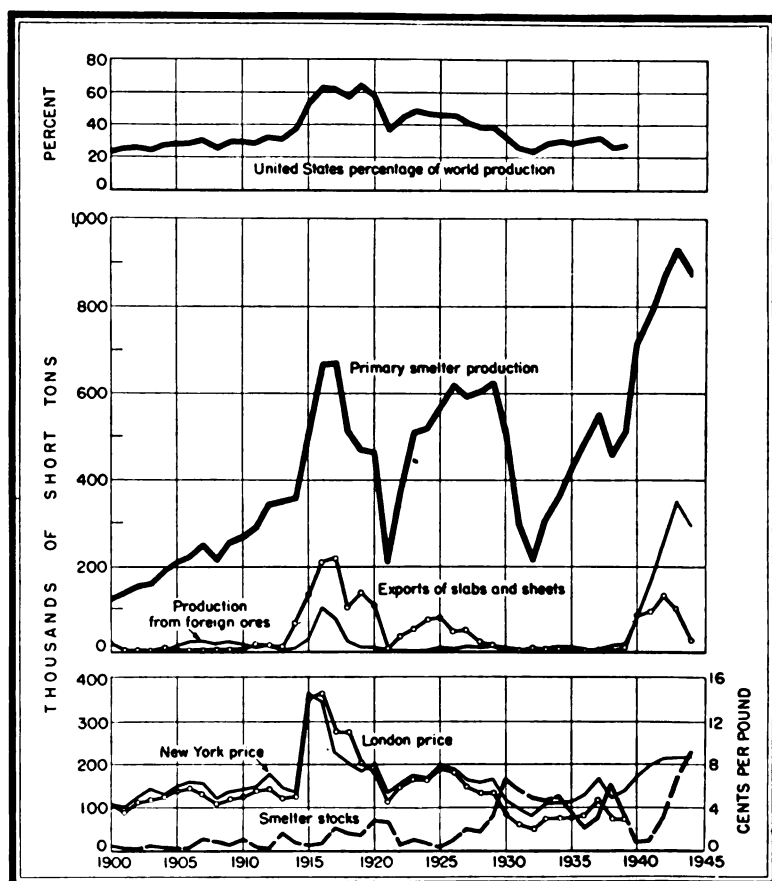


FIGURE 1.—Trends in the zinc industry in the United States, 1900-1944. Imports for consumption of slab and sheet zinc are not shown. Before 1936 they seldom exceeded 500 tons annually, but in recent years they have increased, amounting to 10,164 tons in 1940, 40,559 tons in 1941, 36,402 tons in 1942, 56,155 tons in 1943, and 63,641 tons in 1944.

to make a further cut of 50 percent in the rate of duty prevailing on January 1, 1945, and asked that any extension of the act be limited to 1 year. The cause for alarm was certain language in the measure that could be interpreted to make permanent the temporary 50-percent reduction under the existing Canadian Agreement of 1938 and the Mexican Trade Agreement of 1942 and empower the Executive Branch of the Government to make tariff reductions as much as 75 percent below the rates established by the Tariff Act of 1930. Under the "most-favored-nation" policy, the original reduction embodied in the Canadian and Mexican agreements extended to virtually all countries and would apply equally to the present measure. On June 19 the Senate voted favorably on the bill despite all opposition.

SUPPLY OF ZINC CONCENTRATES

The greatest factor causing the 3-percent decrease in domestic mine production in 1944 was the shortage of labor. Under the circumstances of manpower difficulties, which were increasing by the end

of the year, the total of 718,642 tons of recoverable zinc produced was a creditable achievement. This output, coupled with a large tonnage of imported zinc concentrates, was sufficient to maintain production at smelter and pigment plants at high levels and thereby supply controlled consumption in 1944.

The requirements for zinc in 1945, as estimated by the War Production Board at the end of 1944, were greater than the potential supply from a decreasing domestic output and lower quantity of concentrates available for import. Indications point to a lower overall new supply of concentrates in 1945. Domestic mine production is expected to decrease in the face of continuing labor difficulties, higher costs, and lower-grade ore, and the foreign supply, principally from the Western Hemisphere, undoubtedly will be lower. Mexico and Canada, the chief sources of imports of zinc concentrates, also face the problem of manpower, and shipments from Mexico will continue to be hindered by the extremely poor condition of the transportation system in that country. However, it appears likely that earlier estimates of military zinc requirements (particularly for brass) will be modified—as a result of the German surrender in May—to the point where the lessened supply will be adequate for all demands except nonessential uses.

SMELTING CAPACITY

Despite a continued high level of requirements in 1944, slab zinc production of 918,339 tons was below the record level of 1943 and short of early estimates, owing to a serious labor shortage. Full capacity of smelters was not utilized, and as the effect of the labor shortage was felt at all plants the potential tonnage of zinc lost was appreciable. According to reports to the Bureau of Mines, the zinc-producing plants in the United States on December 31, 1944, had a stated annual capacity to produce 1,033,000 tons of slab zinc under normal operating conditions, allowing for necessary shut-downs for repairs. This figure, which is 5 percent under the reported capacity at the end of 1943, indicates that the 1944 output was 89 percent of capacity as compared with 91 percent in 1943. Primary smelters operated at 86 percent of a stated 670,000-ton capacity (90 percent of a 799,000-ton capacity in 1943), electrolytic plants at 94 percent of a 338,000-ton capacity (98 percent in 1943), and secondary smelters at 57 percent of a 43,000-ton capacity (54 percent of a 44,000-ton capacity in 1943).

The facilities for redistillation of the lower grades of zinc into high-grade metal were used throughout 1944 but to a much less extent than in 1943.

No additional smelting capacity was under construction at the end of 1944, and no units additional to existing plants were planned.

POSTWAR OUTLOOK

The outlook for zinc for a few years after the war depends upon the interrelated factors of production, imports and tariffs, consumption, and price. Because zinc is so closely woven in the over-all pattern of domestic economy, the promptness with which forecast trends become apparent depends upon how soon the vast domestic productive capacity, as a whole, can be directed to peacetime pursuits under competitive conditions.

Production.—The mine production rate during the war period exceeded the peacetime 1925–29 average of 724,720 tons, but the peak of 768,025 tons in 1942 was 1 percent below the record established in 1926, and output since 1942 has declined steadily. The reason for the inability to maintain an increased production under the stimulus of war was the depletion of ore reserves in certain districts—principally the Tri-State—and a growing scarcity of manpower. The postwar availability of labor will not make up for depleted reserves, and some time will elapse before development—neglected in favor of greater output—can again be placed in a normal position relative to directly productive mining. It is doubtful if the high production rate of 1941–44 can be long maintained, and under postwar conditions of probable lower price and tariffs the level of output will be less, possibly in the range of 400,000 to 600,000 tons a year.

Imports.—Postwar readjustments of international trade will be accompanied by an inevitable competitive world market for slab zinc and zinc concentrates. The smelting countries—particularly those that depend largely on imported ore, such as Belgium, France, the United Kingdom, and Holland—will be actively seeking for such raw material in the very countries that were the source of much of the supply for the United States during the war period. In all probability such supply, sufficient to make up a deficit in domestic output of as much as 200,000 tons of zinc, will have to come from the Western Hemisphere—principally Mexico—as indications point to the production of other countries being absorbed by expanded industry at home and by shipment elsewhere than to the United States. Any future lowering of tariff barriers, of course, will have its effect upon the flow of materials into the United States and upon domestic production. Although current Government policy seems to favor tariff reductions, opposition is strong; the probable result will be a compromise allowing some protection in the postwar years but perhaps substantially below that afforded by the Tariff Act of 1930.

Consumption.—Consumer demand during the immediate postwar period no doubt will result in a minimum annual consumption of zinc as metal and in ore for pigments and chemicals of 650,000 tons and perhaps a maximum of 850,000 tons. The change in the use pattern for zinc during wartime is temporary, the emphasis being on brass manufacture rather than galvanizing. Following the war, galvanizing will increase and at least partly offset a decline in brass requirements for military orders, and the use of zinc-base alloys for die casting and stamping dies will return to the prewar level, probably resuming a rising trend. Although rolled-zinc products, zinc oxide, and other uses together consume a much smaller proportion of the total zinc used than either the galvanizing or brass industry, the amount so used will no doubt be equal to and quite likely above prewar levels.

Price.—Bonuses and premiums probably will be eventually dropped, and prices freed of all control and allowed to return to a condition of normal fluctuations in a competitive market. In the absence of control, the price for zinc immediately after the war may rise above the established wartime ceiling, but it is probable—taking the longer-term view—that the price will be lower than at present, although not as low as the general prewar level. Assuming that some tariff protection will remain in force, the factors of demand by the consumer and

higher production costs to the producer will tend to keep the price on a plane relative to an expected generally higher-cost level for all commodities.

DOMESTIC PRODUCTION

PRODUCTION OF PRIMARY AND REDISTILLED SECONDARY SLAB ZINC

The production of 869,302 tons of primary slab zinc in 1944—although high in comparison with prewar figures—was 8 percent below the record established in 1943 and 3 percent under the total primary output in 1942. The use of foreign ore continued at a high level, but the slab zinc produced from this source was 15 percent below the comparable figure for 1943, the first reversal in the upward trend since 1936. Production from domestic ore was lower than in 1943 by 3 percent, thus continuing a trend that has been downward since 1941.

Production of redistilled slab zinc from zinc scrap gained 2 percent over the 1943 figure, the total output being derived almost equally from primary and secondary smelters. Figures for the output of remelted secondary slab zinc are not included with those for redistilled metal. In 1944 the production of slab zinc recovered by remelting purchased scrap amounted to 7,741 tons (7,406 tons in 1943). Zinc rolling mills and other consumers of slab zinc recover much more than this from their own plant scrap, but such metal normally does not enter the market as scrap and therefore is not measured statistically.

Primary and redistilled secondary slab zinc produced in the United States, 1940-44, in short tons

Year	Primary			Redistilled secondary	Total (excludes zinc recovered by remelting)
	Domestic	Foreign ¹	Total		
1940	589,988	85,287	675,275	48,917	724,192
1941	652,599	169,421	822,020	59,503	881,523
1942	629,957	261,915	891,872	53,195	945,067
1943	594,250	348,059	942,309	48,215	990,524
1944	574,453	294,849	869,302	49,037	918,339

¹ Most of the foreign ores smelted in the United States in 1940-41 originated in Mexico, Canada, Newfoundland, and Peru; in 1942, in Mexico, Canada, Argentina, Newfoundland, Australia, and Peru; in 1943, in Mexico, Canada, Argentina, Newfoundland, Australia, and Peru; and in 1944, in Mexico, Canada, Australia, Newfoundland, and Argentina.

² Represents a small tonnage of foreign slab zinc further refined into high-grade metal in the United States.

DISTILLED AND ELECTROLYTIC ZINC

Of the 1944 output of primary zinc, 63 percent was distilled and 37 percent was produced electrolytically compared with 65 and 35 percent, respectively, in 1943.

A decrease in demand for brass products for military uses—due to cut-backs in ammunition orders in the fall of 1944—was the principal factor that caused a 16-percent lower production of the higher grades of slab zinc. Although the available capacity for redistilling Selected and Prime Western zinc into high-grade zinc was only partly utilized, the electrolytic plants—that produce high-grade zinc—were operated at 94 percent of reported capacity. As a result, the output of primary electrolytic zinc was only 4 percent below the record total for 1943,

as compared with a 17-percent drop in production of distilled primary zinc.

Prime Western and Selected were the only grades of slab zinc that showed an increase in production in 1944, the total output being 23 and 19 percent, respectively, above the 1943 figures. In contrast Special High Grade decreased 14 percent and Regular (ordinary) High Grade 17 percent. The original first-stage smelter production of the two lower grades of zinc was somewhat higher than is indicated in the following table, but to avoid duplication the quantity of each grade consumed in the redistilling operation was omitted because the resultant Special and Regular High Grade slab zinc thus produced is included. It is believed that the data shown thus give a more accurate picture of the quantity and grades of zinc actually made available for use. Of the total 1944 production (comparable 1943 figures in parentheses), 31 percent (23 percent) was Prime Western, 27 percent (31 percent) Regular High Grade, 27 percent (30 percent) Special High Grade, 6 percent (6 percent) Intermediate, 6 percent (8 percent) Brass Special, and 3 percent (2 percent) Selected.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1940-44, in short tons

APPORTIONED ACCORDING TO METHOD OF REDUCTION

Year	Electro-lytic pri-mary	Distilled primary	Redistilled secondary ¹		Total
			At pri-mary smelters	At second-ary smelt-ers	
1940.....	187,040	488,235	20,003	28,914	724,192
1941.....	224,313	597,707	27,904	31,599	881,523
1942.....	252,987	638,885	20,978	32,217	945,067
1943.....	329,902	612,407	24,385	23,830	990,524
1944.....	317,388	551,914	24,673	24,364	918,339

APPORTIONED ACCORDING TO GRADE

Year	Grade A		Grade B (Interme-diate)	Grades C and D		Grade E (Prime Western)	Total
	Special High Grade (99.99% Zn)	Regular High Grade (Ordinary)		Brass Special	Selected		
1940.....	195,119	98,940	65,321	80,681		284,131	724,192
1941.....	203,030	177,451	74,797	73,968	5,152	347,125	881,523
1942.....	231,422	250,501	77,527	86,176	26,800	272,641	945,067
1943.....	293,168	303,743	62,700	82,072	20,445	228,396	990,524
1944.....	251,210	251,595	55,928	54,396	24,396	280,814	918,339

¹ For total production of secondary zinc see chapter on Secondary Metals—Nonferrous.

PRODUCTION OF PRIMARY SLAB ZINC BY STATES

Pennsylvania was the leading producer of primary slab zinc in 1944, thus regaining the position held every year but one since 1934. Montana, which displaced Pennsylvania for first place in 1943, was a close second in 1944 and was followed by Illinois. Of the States for which production figures may be released, Oklahoma, Idaho, and Arkansas occupied the next three positions, in order of decreasing importance. Pennsylvania and Oklahoma had greater production

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ent) was Prime West
27 percent (30 perc
Intermediate, 6 perc
percent) Selected.

produced in the United Sta

OF REDUCTION

Redistilled secondary ¹		Total
At primary smelters	At secondary smelters	
20,003	28,914	72,018
27,904	31,599	80,122
20,978	32,217	94,575
24,385	23,830	99,115
24,673	24,364	91,212

GRADE

Grade C and D		Grade E (Prime Western)	Total
	Selected		
40,681		284,131	724,158
18	5,152	347,125	801,222
76	26,800	272,641	945,575
2	20,445	228,396	947,315
96	24,396	280,814	918,338

ary Metals—Nonferrous.

ZINC BY STATES

f primary slab zinc in 1944.
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ZINC

than in 1943, output from the latter State being 51 per
1943 total. Illinois showed the greatest decline—30 p
was caused largely by the curtailed operation of redi
grade zinc into high-grade zinc at one of the smelters l
State. Montana and Idaho, as usual, produced el
only, Illinois and Texas made both electrolytic and d
and all other States confined their operations to dist
Experimental production of slab zinc directly from the
lead-smelter slag by the fuming process continued fo
year at a Missouri plant.

Primary slab zinc produced in the United States, by States where
in short tons

Year	Arkan- sas	Idaho	Illinois	Montana	Okla- homa	Pennsyl- vania	Other States ¹
1940	35,497	37,477	101,819	149,563	96,689	175,352	78,878
1941	44,045	39,285	121,921	176,406	105,885	222,486	111,992
1942	41,649	39,916	175,455	193,486	102,422	231,362	107,582
1943	35,704	41,129	221,680	237,585	72,043	218,058	116,110
1944	31,350	36,562	155,362	224,391	109,100	227,069	110,141

¹ Texas and West Virginia; also Missouri in 1943 and 1944.

² Revised figure.

SECONDARY ZINC

In addition to the redistilled secondary slab zinc
already reported herein, some remelted slab zinc is pro
large quantity of secondary zinc is recovered each year
alloys, zinc dust, zinc pigments, and zinc salts. Addi
tion on secondary zinc is given in the chapter on Second
Nonferrous.

BYPRODUCT SULFURIC ACID

Sulfuric acid made from the sulfur dioxide gases produ
zinc blende (sphalerite) is an important byproduct of
To utilize a larger proportion of their acid-producing c
plants also consume large quantities of sulfur. The
sulfuric acid at zinc-blende roasting plants showed a gai
in 1944.

Sulfuric acid (60° B. basis) made at zinc-blende roasting plants in
1940-44

Year	Made from zinc blende ¹		Made from sulfur		Short tons
	Short tons	Value ²	Short tons	Value ²	
1940	586,912	5,364,376	134,250	1,227,045	721,162
1941	672,177	5,706,783	148,257	1,258,702	820,434
1942	695,242	6,570,037	147,513	1,393,998	842,755
1943	846,875	8,104,594	155,210	1,485,359	1,002,085
1944	804,010	7,991,859	258,184	2,566,349	1,062,194

¹ Includes acid from foreign blende.

² At average of sales of

ZINC DUST

All previous records for production of zinc dust were broken in 1944, the total output (26,511 tons) being 2 percent above the former high point reached in 1943 and 16 percent over the 1942 production. Zinc dust that is statistically reported is restricted to commercial grades that comply with severe specifications as to percentage of unoxidized metal, evenness of grading, and fineness of the particles. Zinc powder and blue powder are not included in the data. The zinc content of the dust produced in 1944 ranged from 95.0 to 99.6 percent and averaged 97.7 percent. Shipments of zinc dust totaled 26,576 tons, of which only 310 tons or 1 percent went to foreign countries (according to data submitted to the Bureau of Mines). This figure is possibly somewhat low, as Government purchases (of which a part was eventually shipped abroad) were not given separately, and a portion of this quantity no doubt was reported as domestic shipments. By far the largest group use of zinc dust is in chemical manufacturing, with sodium hydrosulfite the principal single item. According to data compiled by the Tin-Lead-Zinc Division of the War Production Board, 24,948 tons of zinc dust were used in 1944, of which 11,646 tons (47 percent) went into the making of sodium hydrosulfite. Production and shipments of zinc dust in 1944 were nearly in balance, and, as the amount consumed at manufacturers' plants was small, producers' stocks showed a moderate decrease from 1,521 tons (corrected figure) at the beginning to 1,287 tons at the close of the year.

The average price of zinc dust shipped to domestic consumers in 1944 was 10.1 cents a pound, the same as in 1943. The raw materials used to manufacture zinc dust are reviewed in the chapter on Secondary Metals—Nonferrous. The greater proportion of the production is from zinc scrap, principally galvanizers' dross. The remainder is made from zinc ore, slab zinc, and as a byproduct of zinc refining.

Zinc dust¹ produced in the United States, 1940-44

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per pound			Total	Average per pound
1940.....	20,731	\$3,404,970	\$0.082	1943.....	25,900	\$5,249,980	\$0.101
1941.....	24,429	4,641,580	.095	1944.....	26,511	5,408,244	.102
1942.....	22,805	4,789,050	.105				

¹ All produced by distillation.² Revised figure.

ZINC PIGMENTS AND SALTS

The principal zinc pigments are zinc oxide and lithopone, and the principal salts are the chloride and sulfate. These products are manufactured from various zinc-bearing materials, including ore, metal, scrap, and residues. Details of the production of zinc pigments and salts are given in the chapter on Lead and Zinc Pigments and Zinc Salts.

MINE PRODUCTION

Mine production of recoverable zinc (including that made into zinc pigments) in the United States decreased 3 percent in 1944. A decline in output from 11 of the 21 zinc-producing States could not be balanced by gains from the other States. The continued drop in production from the high point reached in 1942 was essentially due to the manpower shortage, which reached a critical stage in 1944.

Zinc-mining operations are centered in five localities—the Tri-State area of Southeastern Kansas, Southwestern Missouri, and Northeastern Oklahoma; Tennessee-Virginia; Essex County, N. J.; St. Lawrence County, N. Y.; and the Western States (principally Idaho, New Mexico, Colorado, Utah, Montana, and Arizona in descending order of productivity in 1944). The Western States output advanced 5,110 tons (2 percent), but the Central and Eastern States decreased 7,758 tons (3 percent) and 22,906 tons (11 percent), respectively. The Tri-State area (Joplin region) maintained its position as the principal zinc-producing district, with 26 percent of the total United States output, even though production declined 5 percent in 1944. To an appreciable extent, this decrease can be attributed to the over-all labor shortage, but the main factor was a continuing depletion of high- and medium-grade ore reserves—particularly in the Oklahoma portion of the area. Nevertheless Oklahoma continued to be the principal zinc-producing State in the country, contributing 43 percent of the yield from the Central States, but only by the narrow margin of 77 tons above the production from Idaho. Output from the Eastern States decreased 11 percent, largely owing to a decided drop in production from New Jersey which, as a result, took third place in the United States.

The Western States supplied 46 percent of the domestic total output of zinc (43 percent in 1943) despite a drop in production from 5 of the 10 States. Idaho again was the largest producer. For the first time in the mining history of the State the quantity of zinc produced, which advanced 5 percent, exceeded the lead output, principally as the result of the large production from the Bunker Hill slag-fuming plant at Kellogg. New Mexico ranked second among the Western States despite a decline in output. Of the total 1944 production from this State, 88 percent was from the Central district. Colorado took third place over Utah by a narrow margin, both States showing a substantial drop in output. Half of Colorado's production of zinc came from the Eagle mine of the New Jersey Zinc Co., Empire Zinc Division, at Gilman, and 10 properties in Utah contributed nearly the entire State total output in 1944. About two-thirds of Montana's production was recovered at the East Helena slag-fuming plant of the Anaconda Copper Mining Co. The output of zinc from Arizona rose markedly in 1944 to 48 percent above the previous record of 1943; approximately 45 percent came from the Copper Queen and San Xavier mines. Additional data on production by mines and districts can be found in the State chapters.

Mine production of recoverable zinc in the United States, 1925-29 (average) and 1940-44, by States, in short tons

State	1925-29 (average)	1940	1941	1942	1943	1944
Western States:						
Arizona.....	2,628	15,456	16,493	18,522	19,677	29,077
California.....	3,999	79	440	613	1,856	8,455
Colorado.....	32,868	5,060	15,722	32,215	44,094	39,955
Idaho.....	29,128	70,601	79,084	87,256	86,707	91,372
Montana.....	72,519	52,587	60,710	54,715	37,606	36,127
Nevada.....	5,570	11,833	15,129	10,197	13,647	26,699
New Mexico.....	23,351	30,313	37,862	46,461	59,524	50,727
South Dakota.....				115	46	56
Utah.....	44,385	43,788	42,049	45,543	46,896	38,994
Washington.....	575	11,560	14,320	14,398	12,203	11,904
	215,023	241,277	281,809	310,035	322,256	327,366
Central States:						
Arkansas.....	71	440	206	181	96	19
Illinois.....	1,174	4,818	9,198	9,389	5,851	7,262
Kansas.....	114,323	57,032	71,403	55,874	56,944	63,703
Kentucky.....	644	1,278	427	407	931	341
Missouri.....	16,708	12,703	21,932	36,394	30,413	36,626
Oklahoma.....	226,969	162,935	166,602	146,510	114,085	91,449
Wisconsin.....	23,055	5,770	6,238	9,426	14,387	15,549
	382,944	244,976	276,006	258,181	222,707	214,949
Eastern States:						
New Jersey.....	93,839	91,406	93,781	94,040	92,864	80,288
New York.....	7,091	35,686	38,446	45,807	46,000	35,541
Tennessee.....	14,631	34,796	36,170	43,971	41,766	40,831
Virginia.....	11,192	16,927	22,913	15,991	18,603	19,667
	126,753	178,815	191,310	199,809	199,233	176,327
	724,720	665,068	749,125	768,025	744,196	718,642

Mine production of recoverable zinc in the United States, by districts that produced 1,000 tons or more during any year, 1940-44, in short tons

District	State	1940	1941	1942	1943	1944
Joplin region.....	Kansas, Southwestern Missouri, Oklahoma.	232,437	258,837	237,936	200,514	190,270
Coeur d'Alene region.....	Idaho.	62,948	68,321	78,313	79,634	85,227
New Jersey.....	New Jersey.	91,406	93,781	94,040	92,864	80,288
Central.....	New Mexico.	29,573	34,649	42,374	52,215	44,648
Eastern Tennessee.....	Tennessee.	34,796	36,170	43,971	41,766	40,831
St. Lawrence County.....	New York.	35,686	38,446	45,807	46,000	35,541
Smelter (Lewis and Clark County).	Montana.....	14,462	18,751	20,190	24,165	20,623
Red Cliff.....	Colorado.....		10,880	22,880	28,854	20,492
West Mountain (Bingham).....	Utah.....	21,812	20,496	22,634	23,405	19,151
Austinville.....	Virginia.....	16,927	22,913	15,793	17,139	18,257
Pioche.....	Nevada.....	10,773	14,391	8,957	11,991	17,983
Upper Mississippi Valley.....	Iowa, Northern Illinois, Wisconsin.	5,776	7,956	11,126	15,539	17,242
Park City region.....	Utah.....	17,598	16,177	13,026	11,487	9,556
Metaline.....	Washington.....	11,560	14,201	13,620	9,292	9,236
Warren.....	Arizona.....	1,812	2,095	1,449	1,020	8,070
Leadville.....	Colorado.....	172	48	3,344	5,512	7,984
Summit Valley (Butte).....	Montana.....	35,899	38,070	29,313	7,877	7,874
Kentucky—Southern Illinois.	Kentucky—Southern Illinois.	6,090	7,907	8,096	5,630	5,910
Pima.....	Arizona.....				1,390	5,170
Pioneer (Rico).....	Colorado.....	2,607	3,008	2,764	3,652	4,557
Magdalena.....	New Mexico.....	206	2,580	3,185	5,290	4,474
Warm Springs.....	Idaho.....	7,104	8,534	6,260	4,740	4,000
Pioneer (Superior).....	Arizona.....	3,175	4,139	3,884	4,072	3,850
Big Bug.....	do.....	1,740	1,804	2,650	3,009	3,794
Tintic.....	Utah.....	225	797	1,708	2,330	3,450
Hunter Valley.....	California.....					3,346
Old Hat (Oracle).....	Arizona.....			579	2,450	2,521
Harshaw.....	do.....	2,714	3,531	4,825	3,398	2,051
Rush Valley.....	Utah.....	2,971	3,726	7,625	8,880	2,046
Flat Creek.....	California.....				229	1,532
Heddeleston.....	Montana.....		548	1,266	953	1,529

¹ Includes very small quantity produced elsewhere in State.

es, 1925-29 (average)

Mine production of recoverable zinc in the United States, by districts that produced 1,000 tons or more during any year, 1940-44, in short tons—Continued

1942	1943	1944
18,522	19,677	20,711
613	1,856	3,144
32,215	44,094	51,100
87,256	86,707	91,100
54,715	37,606	36,200
10,197	13,647	20,100
46,461	59,524	55,100
115	46	100
45,543	46,896	38,100
14,398	12,203	11,100
310,035	322,256	371,100

181	96	100
9,389	5,851	6,100
5,874	56,944	61,100
407	931	1,100
3,994	30,413	36,100
5,510	114,085	121,100
426	14,387	18,100
181	222,707	214,100
40	92,864	90,100
107	46,000	33,100
1	41,766	40,100
1	18,603	19,100
9	199,233	178,100
744,196	718,642	718,642

cts that produced
tons

1943	1944
200,514	190,270
79,634	85,227
92,864	80,228
52,215	44,648
41,766	40,831
46,000	35,541
24,165	20,627
28,854	20,492
13,405	19,151
7,139	18,257
1,991	17,983
539	17,242
487	9,536
222	9,236
121	8,070
12	7,594
10	7,874
10	5,910
2	5,170
2	4,557
2	4,474
2	4,140
2	3,850
2	3,794
2	3,436
2	3,346
2	2,527
2	2,051
2	2,045
2	1,532
1	1,529

District	State	1940	1941	1942	1943	1944
Ten Mile	Colorado		70	643	971	1,483
Yankee Hill	California				407	1,444
Northport	Washington		103	685	914	1,438
Livingston	Virginia			198	1,456	1,410
Packer Creek	Montana				1,001	1,389
Patagonia	Arizona	990	1,788	1,913	1,931	1,261
Chelan Lake	Washington				1,930	1,074
Sheridan	Montana	6	187	139	519	1,053
Wallapai	Arizona	4,295	2,346	2,244	1,542	1,046
Upper San Miguel	Colorado			390	1,213	828
Montana	Montana	713	1,474	489	203	755
South Mountain	Idaho	540	2,201	1,485	633	696
Animas	Colorado	1,394	832	379	474	576
Eagle	Montana	418	1,048	348	256	92

STOCKS

PRODUCERS' STOCKS

Inventories of slab zinc at producers' plants continued to increase in 1944 and by December 31 were 37 percent above the previous year-end record total attained in 1943. All of the gain was at the primary reduction plants, as stocks at secondary distilling plants, although comparatively small, decreased 64 percent. Of the 233,696 tons on hand at the end of the year, 159,489 tons were Special High Grade and Regular High Grade, and the remainder (74,207 tons) was of lower grades, compared with 98,248 tons and 72,358 tons, respectively, at the end of 1943. The entire inventory gain can be accounted for by the accumulation of high-grade zinc, and the total represents 2½ months' requirements upon the basis of 823,598 tons shipped in 1944.

According to the American Zinc Institute, stocks of slab zinc followed a constant upward trend in 1944 until the high point was reached at the end of November. A subsequent drop by the end of December indicated a possible change in the trend, which was borne out by a continuation of the decline during the first 4 months of 1945.

Stocks of zinc on hand at zinc-reduction plants in the United States at end of year, 1940-44, in short tons

	1940	1941	1942	1943 ¹	1944
At primary reduction plants	19,212	24,212	82,498	168,777	233,044
At secondary distilling plants	761	890	1,942	1,829	652
	19,973	25,102	84,440	170,606	233,696

¹ Revised figures.

Stocks of zinc ore (60 percent concentrates) in the Tri-State district (as reported by the Tri-State Zinc and Lead Ore Producers' Association) on January 1, 1944, were 5,315 tons. The trend during the following 9 months was upward, the high point of the year (reported weekly) being reached on September 23 with a total of 12,770 tons. For the remainder of 1944, stocks showed a general decrease, descending to a low of 4,090 tons on December 2 and closing on December 30

at 4,664 tons. The accumulation of inventories was largely the result of reluctance on the part of the smelters of Tri-State concentrates to accept all such concentrates offered because of the narrowing margin between the rising cost of treatment and the ceiling price for slab zinc produced. In order to maintain a maximum possible production of zinc and prevent excess stock-piling of Tri-State concentrates, the Metals Reserve Company, acting upon a recommendation by the War Production Board, gave financial assistance to Tri-State smelters in the form of special premium payments starting in July 1944. The decline in stocks during the latter part of the year was the belated, though desired, result of this action.

According to an American Zinc Institute survey, total stocks of domestic and foreign zinc ore and concentrates at primary zinc-reduction plants suitable for the production of zinc metal on December 31, 1944, totaled 734,506 tons averaging 54 percent zinc. This compares with 673,247 tons containing 54 percent zinc at the end of 1943.

CONSUMERS' STOCKS

Stocks of slab zinc at consumers' plants decreased markedly in 1944, the total on December 31 being 28 percent below the quantity on hand at the beginning of the year. Inventories decreased rapidly from the high point at the first of the year to about 68,000 tons on March 31, advanced to 79,000 tons by the end of May, and in the following months showed a downward trend, with only minor fluctuations. The reason for the decided drop in stocks was the premature lowering of military requirements for zinc—particularly in the manufacture of brass—in expectation of an end to the European phase of the war in the fall of 1944. The 49-percent drop in slab zinc inventories at brass mills, ingot makers, and foundries reflects this situation. Stocks at zinc-rolling mills advanced 88 percent, the only one of the industry groups to show an increase. At the average monthly rate of consumption in 1944, consumers' stocks on hand at the end of 1944 were less than 1 month's requirements.

In addition to physical stocks on hand at consumers' plants at year's end, 19,000 tons of zinc were in transit to consumers, held for redistillation and in dealers' hands. Exclusive of an indeterminate quantity in bonded warehouses, the approximate total slab zinc in stock (including company- and Government-owned stocks at producers' plants) on December 31, 1944, was 318,000 tons. The comparative figure at the end of 1943 was 277,000 tons.

Consumers' stocks of slab zinc at plants at the beginning and end of 1944, by industries, in short tons

	Galvanizers	Die casters ¹	Brass mills ²	Zinc rolling mills	Oxide plants	Others	Total
Dec. 31, 1943 ³	29,046	6,006	50,218	2,580	1,027	1,479	* 90,356
Dec. 31, 1944	27,230	5,112	25,754	4,862	786	1,475	* 65,219

¹ Includes producers of zinc-base die castings, zinc-alloy dies, and zinc-alloy rods.

² Includes brass mills, brass ingot makers, and brass foundries.

³ Revised figures.

* Stocks on December 31, 1943 and 1944 exclude 783 and 429 tons, respectively, of remelt spelter.

DOMESTIC CONSUMPTION

NEW SUPPLY

The following table shows the 5-year trend of primary slab zinc available for consumption in the United States. This calculated quantity, in effect, is equivalent to the primary slab zinc apparently made available each year for shipment to domestic consumers during the year.

In addition to primary slab zinc, 50,214 tons of redistilled secondary slab zinc were made available to consumers in 1944 after allowance for a decrease in stocks at secondary smelters. Also 7,741 tons of remelt spelter were produced from purchased scrap.

Primary slab zinc available for consumption in the United States, 1940-44, in short tons

	1940	1941	1942	1943	1944
Supply:					
Stock at smelters Jan. 1.....	83,728	19,212	24,212	82,498	168,777
Production.....	675,275	822,020	1,886,810	1,933,828	1,867,225
Imports.....	16,468	34,554	36,352	56,155	63,626
Total available.....	775,471	875,786	947,374	1,072,481	1,099,628
Withdrawn:					
Exports.....	79,091	89,309	133,938	97,439	21,576
Stock at smelters Dec. 31.....	19,212	24,212	82,498	168,790	233,044
Total withdrawn.....	98,303	113,521	216,436	266,229	254,620
Available for consumption.....	677,168	762,265	730,938	806,252	845,008

¹ Adjusted to exclude imported slab zinc further refined into high-grade metal in the United States.

CONSUMPTION

According to reports from 690 plants, representing an estimated 98 percent of the consuming industry in the United States, a record total of 888,626 tons of slab zinc (including 6,982 tons of purchased remelt spelter) were put in process in 1944. The 881,644 tons of slab zinc, excluding the remelt spelter, was 8 percent above the comparable total of 816,777 tons in 1943. Complete data showing consumption of remelt spelter in 1943 were not available. Receipts during 1944 were 863,135 tons. The apparent discrepancy between this figure and the calculated 902,963 tons of primary and secondary slab zinc and remelt spelter shipped to domestic consumers in 1944 can be attributed to incomplete coverage of the survey, receipts by dealers not included in the survey, variations in the quantity of metal in transit from producer to consumer at the beginning and end of the year, and unaccounted-for slab zinc stored in bonded warehouses.

*Consumption of slab zinc in the United States, 1940-44, by industries, in short tons*¹

Industry and product	1940	1941	1942	1943	1944
Galvanizing: ²					
Sheet and strip.....	(3)	129,028	76,106	72,233	119,381
Tubes and pipe.....		69,749	47,085	51,023	50,472
Wire and wire rope.....		41,408	35,216	37,391	44,350
Wire cloth.....		11,307	7,320	(4)	(4)
Fittings.....		(4)	(4)	14,549	14,113
Other ⁴		99,362	81,764	78,005	87,675
	331,205	350,854	247,491	253,201	315,991
Brass products:					
Sheet, strip, and plate.....	(3)	195,714	292,820	287,962	246,402
Rod and wire.....				66,538	70,970
Tube.....				24,456	27,725
Castings and billets.....				16,851	16,703
Copper-base ingots.....				20,384	17,174
Other copper-base products.....				2,888	2,953
	162,614	228,038	319,946	419,079	381,927
Zinc-base alloy:					
Die castings.....	(3)	151,875	58,918	60,115	76,201
Alloy dies and rod.....			21,227	16,067	8,245
Slush and sand castings.....			(7)	143	75
	146,721	151,875	80,145	76,325	84,521
Rolled zinc	60,195	71,795	66,045	48,529	76,524
Zinc oxide	25,344	16,128	7,977	11,496	20,198
Other uses:					
Slush castings.....	(3)	751	552	(4)	(4)
Wet batteries.....		1,767	1,667	1,807	2,174
Desilverizing lead.....		1,431	1,251	2,178	2,051
Light-metal alloys.....		(4)	(4)	1,074	2,047
Miscellaneous ⁵		4,796	3,095	3,088	3,193
	6,978	8,754	6,565	8,147	9,465
Total: All uses	733,057	827,435	728,169	816,777	10 888,626

¹ Based on a canvass of 600 plants in 1940, 1941, and 1942 and a somewhat larger coverage in 1943 and 1944, mostly from small consumers.

² Includes zinc used in electrogalvanizing, but excludes sherardizing.

³ Data on products according to industry not obtained for 1940.

⁴ Separate figures not available but included in total.

⁵ Includes miscellaneous articles not elsewhere mentioned.

⁶ Revised figures.

⁷ Included under "Other uses" in 1941 and 1942.

⁸ Included under "Zinc-base alloy" in 1943 and 1944.

⁹ Includes zinc used in making zinc dust, bronze powder, alloys, chemicals, castings, and miscellaneous uses not elsewhere mentioned.

¹⁰ Includes 6,982 tons of remelt zinc.

The result of partial relaxation of Government control over zinc in 1944 is indicated by certain comparisons of the 1944 data given in the above table with those for 1943. The quantity of zinc used for galvanizing showed a sharp increase of 25 percent, principally as the result of the larger supply of zinc and steel made available for the manufacture of products for civilian use. Zinc consumed in making brass products was 9 percent less than in 1943 because of cutbacks in military orders for cartridge brass. The manufacture of zinc-base alloy increased 11 percent, and zinc for French-process oxide rose sharply to 76 percent above the total for 1943 owing to the need for increased quantities of oxide for military uses.

Zinc for rolled products showed a marked rise of 58 percent in 1944 owing to relaxation of conservation measures. In addition to slab zinc, the rolling mills remelt and reroll the metallic scrap produced

from their fabricating operations. The scrap so treated in 1944 amounted to 21,555 tons—a 68-percent increase from the comparable total processed in 1943. Purchased zinc scrap in the form of zinc clippings, old zinc scrap, and engravers' plates totaling 1,786 tons were melted and rolled in 1944 (811 tons in 1943). The zinc lost in waste products, such as skimmings and ashes, totaled 1,999 tons in 1944, equivalent to 2.6 percent of the net production of rolled zinc. Production of rolled zinc from slab zinc and purchased scrap (including 74 tons of purchased remelt spelter) was 76,489 tons, an increase of 59 percent over the total for 1943. The total value of the rolled products was 65 percent more than in 1943 owing to a slight increase in the average price from \$0.120 in 1943 to \$0.124 in 1944. Inventories of rolled zinc were 1,711 tons on December 31, 1944, compared with 1,359 tons (revised figure) on the same date in 1943. In addition to the actual shipments of 48,503 tons of rolled zinc in 1944, the rolling mills processed 49,189 tons of rolled zinc (including that which was remelted and rerolled) in the manufacture of 27,634 tons of semifabricated and finished products.

Rolled zinc produced and quantity available for consumption in the United States, 1943-44

	1943			1944		
	Short tons	Value		Short tons	Value	
		Total	Average per pound		Total	Average per pound
Production:						
Sheet zinc not over 0.1 inch thick.....	9,099	\$2,571,000	\$0.141	10,902	\$3,154,000	\$0.145
Boiler plate and sheets over 0.1 inch thick.....	3,628	807,000	.111	5,998	1,365,000	.114
Strip and ribbon zinc ¹	33,979	7,647,000	.113	58,230	13,997,000	.120
Foil, rod, and wire.....	1,420	497,000	.175	1,359	504,000	.185
Total rolled zinc.....	48,126	11,522,000	.120	76,489	19,020,000	.124
Imports.....	(²)			15	2,500	.085
Exports.....	2,281	624,100	.137	3,403	878,700	.129
Available for consumption.....	46,113			72,749		
Value of slab zinc (all grades).....			.086			.086
Value added by rolling.....			.034			.038

¹ Figures represent net production. In addition, 12,809 tons of strip and ribbon zinc in 1943 and 21,555 tons in 1944 were rerolled from scrap originating in fabricating plants in connection with zinc rolling mills.

² Less than 1 ton.

³ Allowances made for change in producers' stocks of rolled zinc.

The following table shows the six commercial grades of refined slab zinc and purchased remelt spelter consumed by the various industries in 1944. Of the 888,626 tons of domestic and foreign zinc consumed, 35 percent was Prime Western, 27 percent Special High Grade, and 24 percent Regular High Grade. All grades of zinc were used for galvanizing and in brass manufacture. Prime Western was the principal grade used in the hot-dip process of galvanizing, the higher

grades—largely in the form of anodes—being used chiefly for electro-galvanizing. Rigid specifications in brass manufacture necessitate the use of high-purity metal, 78 percent of the total used in this industry being of the two highest grades.

Consumption of slab zinc in the United States in 1944, by grades, according to industry, in short tons

	Special High Grade	Regular High Grade	Inter- mediate	Brass Special	Selected	Prime Western	Remelt	Total
Galvanizing.....	10,242	7,987	9,889	7,531	792	275,492	4,058	315,991
Brass products.....	139,368	156,685	25,449	21,754	10,742	26,690	1,239	381,927
Zinc-base alloy.....	83,131	1,072	67	8	-----	184	59	84,521
Rolled zinc.....	3,056	28,838	9,153	25,932	-----	9,471	74	76,524
Zinc oxide.....	4,977	14,180	-----	44	-----	-----	997	20,198
Other uses.....	1,561	2,450	1,460	313	2	3,124	555	9,465
Total.....	242,335	211,212	46,018	55,582	11,536	314,961	6,982	888,626

PRICES

The base ceiling price of 8.25 cents a pound for Prime Western grade slab zinc at St. Louis and \$55.28 per ton of 60-percent zinc concentrates at Joplin remained unchanged throughout the year. In comparison, the weighted average price received by the zinc producers for all grades of zinc sold in 1944 was 8.6 cents a pound, f. o. b. plants, the same as in 1943. The 1944 price of 11.4 cents for zinc, which appears in the State chapters, represents the above weighted average price received for slab zinc plus the increment—in terms of cents per pound based upon the total mine output of recoverable zinc—of \$39,908,642 paid by the Metals Reserve Company in 1944 in over-quota A, B, and C premiums and under special mine and smelter contracts.

The premium-price plan, whereby producers (miners) of zinc (copper and lead were also included in the plan) receive additional increments above the ceiling price (through Metals Reserve Company) for overquota production, was maintained throughout 1944. As the plan is operative only until July 31, 1945, Congress passed the Hayden-McFarland Bill, S-502, on June 14, 1945, thereby extending the time limit to June 30, 1946. More complete details of the scope of the premium-price plan—which was effective February 1, 1942—can be found in the chapter on Zinc in the Minerals Yearbook of 1942 and 1943. In May 1945 the Office of Price Administration released a comprehensive compilation of data showing production of copper, lead, and zinc under the premium-price plan since February 1942, at the various quota levels and the payments made. In addition, details of payments under special mine and smelter contracts for zinc were given. The salient statistics from this report with reference to zinc are shown in the following table:

Salient statistics on zinc with regard to operation of premium-price plan, 1942-44

	1942 ¹		1943		1944	
	Tri-State district	U. S., exclusive of Tri-State	Tri-State district	U. S., exclusive of Tri-State	Tri-State district	U. S., exclusive of Tri-State
Total production of recoverable zinc ² short tons	216,367	479,881	200,103	540,565	200,341	515,465
Ceiling production at 8.25 cents a pound..... short tons	95,050	400,984	11,930	326,251	20,911	251,105
Percent of ceiling production to total production..... percent	43.93	83.56	5.96	60.35	10.44	48.71
Production under premium-price plan:						
"A" quota (11.00 cents a pound)..... short tons	120,681	75,617	92,650	146,639	65,714	171,328
"B" quota (13.75 cents a pound)..... short tons	573	1,923	58,243	40,045	65,779	56,015
"C" quota (16.50 cents a pound)..... short tons	63	734	34,803	22,778	42,080	31,421
Total premium production..... short tons	121,317	78,274	185,696	209,462	173,573	258,764
Metals Reserve Company mine contracts..... short tons		623	2,477	4,852	5,857	5,596
Total over-ceiling production..... short tons	121,317	78,897	188,173	214,314	179,430	264,360
Percentage of over-ceiling production to total:						
Production under premium-price plan:						
"A" quota..... percent	55.78	15.76	46.30	27.13	32.80	33.24
"B" quota..... do.....	.26	.40	29.11	7.41	32.83	10.87
"C" quota..... do.....	.03	.15	17.39	4.21	21.01	6.09
Total premium production, do.....	56.07	16.31	92.80	38.75	86.64	50.20
Metals Reserve Company mine contracts..... do.....		.13	1.24	.90	2.92	1.09
Total over-ceiling production, do.....	56.07	16.44	94.04	39.65	89.56	51.29
Payments under premium-price plan: ³						
"A" quota..... dollars	6,672,409	4,305,059	10,213,269	11,520,444	9,546,487	14,283,080
"B" quota..... do.....	34,936	146,141	5,117,544	3,455,281	5,932,208	4,809,086
"C" quota..... do.....	3,446	40,394	1,914,183	1,252,814	2,314,401	1,728,271
Total premium production, do.....	6,710,791	4,491,594	17,244,996	16,228,539	17,793,096	20,820,437
Metals Reserve Company payments to smelters ⁴ dollars					402,580	
Metals Reserve Company mine contracts ⁵ do.....		36,501	225,005	280,353	578,737	313,792
Total over-ceiling payments..... do.....	6,710,791	4,528,095	17,470,001	16,508,892	18,774,413	21,134,229
Average prices per pound of zinc: ⁴						
Average premium production, cents.....	11.016	11.119	12.893	12.124	13.376	12.273
Metals Reserve Company mine contracts..... do.....		11.179	12.791	11.139	13.190	11.054
Total over-ceiling production, do.....	11.016	11.120	12.892	12.102	13.482	12.247
Total production..... do.....	9.801	8.722	12.615	9.777	12.936	10.300

¹ Premium-price plan effective February 1, 1942; data refer to February-December, inclusive.² Production of Tri-State zinc from Metals Reserve Company agency, Joplin, Mo., all other from Bureau of Mines monthly reports. These data are preliminary and do not exactly equal final annual totals for the United States.³ Data on premium payments, payments to smelters, and Metals Reserve Company mine contract payments from Metals Reserve Company. All payments shown are subject to correction due to additional payments as a result of retroactive quota adjustments, late reports by smelters and custom mills, etc.⁴ All average prices shown include Office of Price Administration ceiling price of 8.25 cents a pound for zinc.

The official London maximum price per long ton of £25 15s. for foreign zinc delivered to consumers, duty paid, and £26 10s. for domestic metal remained unchanged throughout 1944.

Price of zinc and zinc concentrates, 1940-44

	1940	1941	1942	1943	1944
Average price common zinc at—					
St. Louis (spot)..... cents per pound	6.34	7.48	8.25	8.25	8.25
New York..... do	6.73	7.87	8.66	8.66	8.65
London..... do	(1)	(1)	(1)	(1)	(1)
Excess New York over London..... do	(2)	(2)	(2)	(2)	(2)
Joplin 60-percent zinc concentrates:					
Price per short ton..... dollars	41.87	49.80	55.28	55.28	55.28
Price of zinc content..... cents per pound	3.49	4.15	4.61	4.61	4.61
Smelter margin..... do	2.85	3.33	3.64	3.64	3.64
Price indexes (1925-29 average=100):					
Zinc (New York).....	95	111	122	122	122
Lead (New York).....	69	78	87	87	87
Copper (New York).....	77	80	80	80	80
Nonferrous metals ¹	82	85	87	87	87
All commodities ²	80	89	101	105	106

¹ Official maximum price fixed by British Ministry of Supply at £25 15s., equivalent to 4.64 cents a pound at the official 1941-44 rate of exchange.

² Not available.

³ Based upon price indexes of U. S. Department of Labor.

Average monthly quoted prices of common zinc (prompt delivery or spot) at St. Louis and London, and of 60-percent zinc concentrates at Joplin, 1943-44¹

Month	1943			1944		
	60-percent zinc concentrates in the Joplin region (dollars per ton) ²	Metallic zinc (cents per pound)		60-percent zinc concentrates in the Joplin region (dollars per ton) ²	Metallic zinc (cents per pound)	
		St. Louis	London		St. Louis	London
January.....	\$55.28	8.25	(1)	\$55.28	8.25	(2)
February.....	55.28	8.25		55.28	8.25	
March.....	55.28	8.25		55.28	8.25	
April.....	55.28	8.25		55.28	8.25	
May.....	55.28	8.25		55.28	8.25	
June.....	55.28	8.25		55.28	8.25	
July.....	55.28	8.25		55.28	8.25	
August.....	55.28	8.25		55.28	8.25	
September.....	55.28	8.25		55.28	8.25	
October.....	55.28	8.25		55.28	8.25	
November.....	55.28	8.25		55.28	8.25	
December.....	55.28	8.25		55.28	8.25	
Average for year.....	55.28	8.25	(1)	55.28	8.25	(1)

¹ Quotations from Metal Statistics, 1945.

² Does not include Government premium of \$29.70 a ton on zinc concentrates payable for overquota production.

³ Official maximum price fixed by British Ministry of Supply at £25 15s., equivalent to 4.64 cents a pound at the official 1942-44 rate of exchange.

Average price received by producers for zinc, 1940-44, by grades, in cents per pound

	1940	1941	1942 ¹	1943 ¹	1944 ¹
Grade A:¹					
Special High Grade.....	6.59	8.04	9.00	8.91	8.90
Regular High Grade.....		7.74	9.10	8.74	8.62
Grade B: Intermediate.....		7.52	8.64	8.71	8.74
Grades C and D:¹					
Brass Special.....	6.04	7.37	8.32	8.46	8.48
Selected.....		6.64	8.18	7.95	8.27
Grade E: Prime Western.....	6.14	7.16	8.23	8.31	8.24
All grades.....	6.3	7.5	8.7	8.6	8.6
Prime Western; spot quotation at St. Louis.....	6.3	7.5	8.25	8.25	8.25

American Metal Market quotes average prices of High Grade and Brass Special as follows: High Grade (f. o. b. New York)—1940, 7.38 cents; 1941, 8.48 cents; 1942, 9.25 cents (delivered); 1943, 9.25 cents (delivered); 1944, 9.25 cents (delivered). Brass Special (f. o. b. East St. Louis)—1940, 6.44 cents; 1941, 7.68 cents; 1942, 8.50 cents; 1943, 8.50 cents; 1944, 8.50 cents.

¹ Does not include overquota premium payments made by Metals Reserve Company.

ZINC-REDUCTION PLANTS**ZINC SMELTERS**

There was no change in the number of zinc smelters in 1944. For the past 4 years there have been 17 active commercial plants, of which 13 operated with horizontal retorts exclusively, 1 with both horizontal and vertical retorts, 2 with large vertical retorts exclusively, and 1 with electrothermic furnaces. The total number of retorts reported at the horizontal-retort primary plants was 71,912, a decrease of 1 percent from the 72,712 at these plants on December 31, 1943. Of the total retorts reported, 52,000 were in use at the close of 1944, a decline of 24 percent from the 68,232 in operation at the end of 1943. This marked decline was due entirely to the critical shortage of labor, which necessitated suspending operation of several blocks of retorts at each plant. Only 72 percent of the total retorts available in the United States was in operation at the end of 1944 as compared with 94 percent at the close of 1943. Of the 66 vertical retorts in the United States, 61 were in operation on December 31, 1944.

Eight primary plants in 1944 (9 in 1943) produced zinc from zinc scrap and residues such as zinc skimmings and dross. In addition to the 17 primary smelters, 9 plants (11 in 1943) produced redistilled secondary slab zinc by treating scrap zinc and other secondary zinc-bearing materials in clay retorts, graphite crucibles, and 2 special furnace installations. These 9 plants reported a total of 2,552 retorts and 91 crucibles on December 31, 1944, of which 1,320 retorts and 37 crucibles were in operation. Part of the available production capacity at secondary plants was used to produce zinc dust and zinc oxide in addition to slab zinc.

The St. Joseph Lead Co. continued experimental operation of its slag-fuming plant at Herculaneum, Mo., in 1944 for the recovery of slab zinc as a direct product of the operation which treats lead blast-furnace slag containing 12 to 16 percent zinc. Descriptions of the process² and the unique type of vacuum condenser used³ were published in 1944.

ELECTROLYTIC PLANTS

Five electrolytic plants were in operation during 1944, the same as in 1943, but only 2 produced at capacity throughout the year. There were 3,210 cells at the plants on December 31, 1944, of which 2,994 (93 percent) were in operation. No new installations were reported under construction or planned. A detailed description of the newest plant, built in 1942 by the American Smelting & Refining Co. at Corpus Christi, Tex., was published in 1944.⁴

FOREIGN TRADE⁵**IMPORTS**

During 1944 imports of zinc continued at a high rate, but the total in ore and as slab zinc was 18 percent below the record established in 1943. Of the 422,700 tons of zinc imported in ore, 42 percent

² Isbell, W. T., and Long, Carleton C., Direct Production of Metallic Zinc from Lead Blast-furnace Slag: Trans. Am. Inst. Min. and Met. Eng., vol. 159, 1944, pp. 176-181.

³ Najarian, H. K., Wheaton-Najarian Vacuum Condenser: Trans. Am. Inst. Min. and Met. Eng., vol. 159, 1944, pp. 161-175.

⁴ Cunningham, George H., and Jephson, Allen C., Electrolytic Zinc at Corpus Christi, Tex.: Trans. Am. Inst. Min. and Met. Eng., vol. 159, 1944, pp. 194-209.

⁵ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

came from Mexico, 27 percent from Canada, and 10 percent each from Peru and Australia. Receipts from Mexico and Canada continued to gain, but imports of ore from Australia were down to a third of the 1943 total. The quantity from Argentina, another source of large tonnage in 1943, was also markedly lower. The principal reason for the decline from Argentina and Australia was that the large stock piles of ore that furnished the greater part of the record exports to the United States in 1943, for the most part, were depleted during that year, and shipments in 1944 came chiefly from current production. The substantial gain in imports of ore from Peru reflected the increased activity in zinc mining in that country. Imports of slab zinc continued to increase in 1944, despite a lower tonnage from Mexico, largely owing to a 111-percent gain in receipts from Canada.

*Zinc imported into the United States in ore, blocks, pigs, or slabs, 1942-44, by countries, in short tons*¹

Country	1942	1943	1944
Ore (zinc content):			
Argentina.....	23,395	53,452	19,872
Australia.....	32,212	120,244	42,216
Belgian Congo.....	2,873	14,835	.....
Bolivia.....	5,893	2,760	5,305
Canada.....	78,104	110,343	112,299
Chile ²	6,872	14,369	2,477
Mexico.....	160,959	166,135	177,629
Newfoundland and Labrador.....	30,550	32,949	19,013
Peru.....	27,506	21,901	43,889
Other countries.....	44	(³)	.....
	368,408	536,988	422,700
Blocks, pigs, or slabs:			
Canada.....	1,749	8,570	18,099
Mexico.....	34,603	45,344	39,703
Other countries.....	.....	2,241	5,824
	36,352	56,155	63,626

¹ Data include ore imported for immediate consumption plus material entering country under bond.

² Substantially all zinc shown as received from Chile originated in Bolivia and was shipped from Chilean ports.

³ Less than 1 ton.

Zinc imported for consumption in the United States, 1940-44, by classes

Year	Ores (zinc content)		Blocks, pigs, or slabs		Sheets		Old, dross and skimmings ¹		Zinc dust		Total value ²
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
1940.....	44,637	\$1,108,361	10,146	\$801,331	18	\$2,796	520	\$36,689	.....	.....	\$1,949,177
1941.....	154,520	4,596,480	40,288	3,661,549	271	54,464	456	31,695	140	\$21,495	8,365,683
1942.....	283,167	10,723,983	36,352	2,924,438	50	10,086	3,357	158,929	702	43,464	13,860,900
1943.....	516,646	20,475,688	56,155	5,825,874	(³)	56	5,146	226,754	106	17,585	26,545,957
1944.....	415,004	18,678,957	63,626	6,162,877	15	2,540	5,603	300,188	.....	.....	25,144,562

¹ Includes dross and skimmings as follows—1940: 356 tons, \$21,815; 1941: 353 tons, \$23,028; 1942: 3,214 tons \$150,913; 1943: 5,032 tons, \$216,425; and 1944: 4,694 tons, \$224,995.

² In addition, manufactures of zinc imported as follows—1940: \$32; 1941: \$1,099; 1942: \$16; 1943: \$35,355; 1944: \$14,223.

³ Less than 1 ton.

EXPORTS

The value of exports of zinc ore (and concentrates) and manufactured articles containing zinc of foreign and domestic origin (excluding galvanized products, alloys, and pigments) amounted to \$4,857,365 in 1944 compared with \$19,322,462 in 1943. Slabs, plates, or blocks continued to be the largest export group, but the total shipped to foreign countries decreased 78 percent—from 97,439 tons in 1943 to 21,576 tons in 1944. In addition to the items shown in the accompanying tables, considerable zinc is exported each year in brass, pigments, chemicals, and galvanized iron and steel. Export data on zinc pigments and chemicals are given in this volume in the chapter on Lead and Zinc Pigments and Zinc Salts. Much of the zinc used in the manufacture of such products is of foreign origin, and when they are exported a draw-back of 99 percent of the import duty is refunded upon the basis of zinc contained in the finished product. Data covering draw-back in 1943 and 1944 are not yet available. Draw-back payments were made on 23,047 tons in 1942.

Slab and sheet zinc exported from the United States, 1941-44, by destinations, in short tons

Destination	Slabs, plates, and blocks				Sheets, strips, or other forms, n. e. s.			
	1941	1942	1943	1944	1941	1942	1943	1944
Country:								
Argentina.....	862	67	—	—	504	210	91	146
Australia.....	—	171	(¹)	—	464	558	48	—
Brazil.....	1,004	—	1,528	1,069	125	73	79	145
Canada.....	—	5,918	13,347	4,132	1,247	1,071	2,160	2,704
Chile.....	196	429	107	17	144	476	24	18
China.....	1,947	1,580	2,170	—	102	11	5	5
India and dependencies.....	11,553	8,896	5,818	—	672	1,026	1	4
Japan.....	175	—	—	—	—	—	—	—
Mexico.....	400	110	161	473	311	207	196	278
U. S. S. R.....	480	13,439	23,477	1,151	—	101	—	—
United Kingdom ²	71,325	103,086	48,540	14,669	209	5	2	8
Other countries.....	1,367	242	2,291	65	1,468	1,029	561	712
	89,309	133,938	97,439	21,576	5,246	4,767	3,167	4,020
Continent:								
North America.....	433	6,073	13,509	4,621	1,721	1,490	2,389	3,095
South America.....	2,416	826	1,652	1,112	976	804	317	438
Europe.....	71,805	116,525	72,017	15,820	320	113	74	97
Asia.....	14,394	10,480	7,991	22	1,431	1,212	13	10
Africa.....	1	34	2,269	1	239	485	322	379
Oceania.....	260	—	1	(¹)	559	663	52	1

¹ Less than 1 ton.

² United Kingdom of Great Britain and Northern Ireland.

Zinc ore and manufactures of zinc, exported from the United States, 1940-44

Year	Zinc ore, concentrates, and dross (zinc content)		Slabs, plates, or blocks		Sheets, strips, or other forms, n. e. s.		Zinc dust	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	448	\$42,207	79,091	\$9,103,030	7,490	\$1,564,720	3,044	\$592,271
1941.....	—	—	89,309	12,712,121	5,246	1,328,516	2,901	676,876
1942.....	(¹)	18	133,938	22,828,929	4,767	1,289,889	1,772	417,957
1943.....	1	305	97,439	17,167,729	3,167	891,132	5,859	1,263,296
1944.....	(¹)	38	21,576	3,717,643	4,020	1,065,206	295	74,478

¹ Less than 1 ton.

WORLD ASPECTS OF THE ZINC INDUSTRY

The rapid succession of events in 1944 and 1945, culminating in the unconditional surrender of Germany in May 1945, paved the way toward revealing greater detail regarding the zinc industry in foreign countries than had been available since 1939. Censorship restrictions have been removed by the governments of most of the zinc-producing countries, and unrestricted information relative to the zinc industry in European countries formerly under Axis control is beginning to flow by way of official channels. It is not possible, however, to present with any accuracy the picture of world production and consumption of zinc during the years of the European phase of the war. The United Nations had ample supplies of zinc to meet all war requirements and most of the essential civilian needs in 1944. Total production of slab zinc from the United States, Canada, and Mexico, which represents more than half the world output, was less in 1944 than in 1943, and output from European smelters can hardly have increased under conditions existing in 1944, if for no other reasons than lack of ore, fuel, and adequate transportation facilities. In the face of an indicated decrease in world production, the maintenance of consumption at a high level could have been made possible only at the expense of accumulated stocks.

*World smelter production of zinc, 1938-44, by countries where smelted, in metric tons*¹

[Compiled by B. B. Waldbauer]

Country	1938	1939	1940	1941	1942	1943	1944
Australia.....	70,941	72,363	76,736	80,840	78,180	73,506	79,398
Belgium ²	210,400	185,700	³ 65,000	(⁴)	(⁴)	(⁴)	(⁴)
Canada.....	156,008	159,338	168,486	193,784	195,769	187,342	153,934
Czechoslovakia.....	8,876	(⁵)	(⁵)	(⁴)	(⁴)	(⁴)	(⁴)
France.....	54,713	61,019	37,843	25,918	22,829	17,770	8,367
Germany ⁶	194,370	⁷ 212,285	(^{7,8})	(⁴)	(⁴)	(⁴)	(⁴)
Indochina.....	4,470	5,439	6,700	(⁴)	⁹ 4,647	(⁴)	(⁴)
Italy.....	33,367	35,398	³ 40,000	(⁴)	(⁴)	(⁴)	(⁴)
Japan.....	³ 50,000	(⁵)	³ 55,000	³ 65,000	(⁴)	(⁴)	(⁴)
Mexico.....	35,881	35,369	33,388	38,678	51,743	54,449	46,030
Netherlands.....	25,300	20,500	³ 6,000	(⁴)	(⁴)	(⁴)	(⁴)
Northern Rhodesia.....	10,379	12,899	13,402	13,762	(⁴)	(⁴)	(⁴)
Norway.....	46,523	45,917	17,229	6,464	7,507	15,371	(⁴)
Poland.....	108,071	117,936	³ 120,000	(⁴)	(⁴)	(⁴)	(⁴)
Spain.....	7,672	13,396	12,322	19,143	19,150	19,200	18,048
Union of Soviet Socialist Republics.....	³ 80,000	(⁵)	(⁵)	(⁴)	(⁴)	(⁴)	(⁴)
United Kingdom ⁶	56,190	50,440	³ 60,000	(⁴)	(⁴)	(⁴)	(⁴)
United States.....	404,912	460,154	612,596	745,720	809,088	854,844	788,613
Yugoslavia.....	3,956	4,182	6,025	(⁴)	(⁴)	(⁴)	(⁴)
	1,562,000	1,638,000	1,635,000	(⁴)	(⁴)	(⁴)	(⁴)

¹ Statistical data derived in part from American Bureau of Metal Statistics, Yearbook.

² Includes 3,670 tons of electrolytic zinc in 1938. Data not available for later years. Production of electrolytic zinc began in August 1935.

³ Estimate.

⁴ Data not available.

⁵ Included with Germany.

⁶ Some secondary metal included.

⁷ Includes Czechoslovakia.

⁸ Estimate included in total.

⁹ January to June, inclusive.

REVIEW BY COUNTRIES

Argentina.—Production of zinc concentrate in 1944 was 38,588 metric tons, an increase of 4 percent from the 37,185-ton output in 1943. The concentrate, nearly all of which is from the Aguilar mine, has averaged 54 percent zinc. Output of electrolytic zinc totaled

1,500 metric tons from a small plant at Uriburu, in the Province of Buenos Aires. Production in 1943 was 900 tons.

Australia.—The problem of obtaining sufficient manpower continued in 1944, but a reduction in the amount of ore treated by the Zinc Corp., Ltd.—due to labor shortage—was somewhat counterbalanced by an improvement in the grade. Although exploration and development has been curtailed to release labor to meet production requirements, the ore reserves have remained at roughly 4,000,000 long tons, averaging 11.5 percent zinc and 14.3 percent lead. The zinc content of concentrate produced in 1944 is reported to have been 50,361 short tons as compared to 49,959 tons in 1943.

Mount Isa Mines, Ltd., is reported to have 8,000,000 long tons of lead-zinc ore in reserve, containing 8.6 percent lead and 8 percent zinc.

Production data are being released by the Australian authorities but official figures had not been received at the time of writing (June 1945). Data from an unofficial source indicate that total mine production of zinc (recoverable zinc content of concentrates) in Australia was 150,800 short tons in 1944 (159,000 tons in 1943).

Belgium.—One of the paramount questions confronting the zinc industry—the status of the Belgian smelting industry and condition of the zinc plants during the German occupation of that country and subsequent to their retreat in the fall of 1944—has been answered. Although complete details are not available, it is understood that the smelters are substantially intact, having escaped serious damage by military operations or deliberate destruction by the retreating Germans. Production during the period of German occupation was but a fraction of capacity, and the resulting deterioration from several years of nearly complete idleness will necessitate considerable rehabilitation before full-scale operations can be resumed. Such repair work should not take many months providing adequate materials are available, but the principal draw-backs to resumption of operations at an early date are lack of fuel and concentrates and adequate transportation facilities.

Bolivia.—Mine production of zinc in Bolivia decreased from 21,074 metric tons (zinc content in ore and concentrate) in 1943 to 16,319 tons in 1944, mostly from the Huanchaca mine. The Matilde mine near Lake Titicaca, owned by the Compania Hochschild, was reported to have—as of 1944—some 4,000,000 metric tons of ore in reserve, containing an average of 18.7 percent zinc and 2.5 percent lead, 0.7 percent copper, and 1.75 ounces of silver per ton.

Burma.—The famous, centuries-old, Bawdwin lead-zinc mine—which before the war produced 40,000–50,000 tons of zinc in concentrate a year—was reported recaptured from the Japanese early in 1945. Not long before the recovery of the mine, the property was bombed by the Allies. As the ore reserves, as last reported before the war, indicated a relatively short remaining life, doubts have been expressed as to its being reopened if damage is found to be severe.

Canada.—Mine production of zinc in Canada in 1944 amounted to 264,667 short tons (preliminary), a decrease of 13 percent from the 305,377-ton output in 1943. Refined zinc production was 169,684 tons (preliminary) compared with 206,510 tons in 1943. Of the total output (all electrolytic), 70 percent was produced by the Consolidated Mining & Smelting Co., at Trail, British Columbia, and 30 percent by the Hudson Bay Mining & Smelting Co., Ltd., at Flin Flon, Manitoba.

The 250-ton mill of the Aldermac Mining Corp. at Sherbrooke, Quebec (reported in 1943 to be planned) went into operation in July 1944. The ore treated averages 7 percent zinc, 2.5 percent copper, 2 percent lead, and some gold and silver. The Normetal Mining Corp. increased production in 1944 under a contract for sale of the bulk of the zinc concentrates to the United States Government. The Zincton Mines, Ltd.—operating a 200-ton-a-day mill—continued production throughout 1944. In July the Department of Munitions and Supply announced that the Twin "J" mines, Duncan, British Columbia, Kootenay-Florence mine, Ainsworth, British Columbia, Lake Geneva mine, Benny Siding, Ontario, and Tetreault mines, Notre Dame des Anges, Quebec, had suspended operations. These four high-cost lead-zinc properties had produced under contract for the United States Metals Reserve Company. It was reported that existing contracts between principal Canadian producers and the British Government were renewed for 1 year from September 1, all contracts being terminable—should the war end—on 3 months' notification. At the end of 1944 the Hudson Bay Mining & Smelting Co., Ltd., had 531,000 tons of zinc-plant residues in storage. Some progress had been made in developing a process for treatment, but a satisfactory recovery method applicable to the recovery of all contained metals had not yet been found.

France.—The zinc-smelting industry in France depends largely on imported ores, but beginning in 1941 increased quantities of zinc concentrates were produced in France, partly from mixed lead-zinc ores, and from the Pierrefitte zinc mine in the Pyrénées. However, the entire output amounts to less than 5 percent of prewar domestic requirements. Mine production of zinc (content of zinc in ores and concentrates) from 1938 through 1944, in metric tons, was as follows:

Year	1938	1939	1940	1941	1942	1943	1944
Production.....	95	500	1,420	3,055	3,215	2,648	2,387

Until shipping is available for imports of lower-cost zinc concentrates, most of the zinc smelters in France will remain idle, and the country will depend on imports of zinc metal for its most urgent requirements.

French Morocco.—Production of zinc from 1940 through 1944 was as follows (data in metric tons):

Year	1940	1941	1942	1943	1944
Ore and concentrates.....	4,553	1,142	1,484	976	2,229
Zinc content.....	2,276	721	742	488	1,137

Mexico.—Production of zinc in Mexico continued to advance, despite many unfavorable conditions, the total output—in terms of zinc in exportable ore plus smelter production—amounting to 219,309 metric tons compared with 197,199 tons in 1943. A general labor strike against some 140 mining and smelting companies was called on June 8 and was not completely settled until August 11. Severe floods in the fall of 1944 further complicated the problem of transportation,

already critical by virtue of a shortage of railway cars and run-down condition of the railway system.

Newfoundland.—Mine production of zinc, in terms of zinc content of all concentrates produced, amounted to 59,472 short tons compared with 66,418 tons in 1943. This tonnage was from 98,813 tons of 53-percent zinc concentrate (108,642 tons in 1943) and includes 7,542 tons of zinc contained in lead and copper concentrates (8,874 tons in 1943).

Peru.—The zinc content of concentrates produced in Peru during 1944 has been estimated to total 56,263 metric tons compared with 31,347 tons in 1943. This estimate is based upon reports of the major zinc-producing companies, of which group the largest is the Cerro de Pasco Copper Corp. The 800-ton daily capacity concentrating plant of this company, which started production late in October 1943, operated throughout 1944 on copper ore. The plant was built primarily for the treatment of lead-zinc ores in connection with a projected commercial-scale electrolytic zinc plant which has not yet been constructed. The electrolytic zinc pilot plant operated by the company produced 1,441 metric tons of zinc in 1944.

The tailings plant of Cia Minera Atacocha, S. A., Department of Junin, was finally completed in the summer of 1944. The zinc concentrates from the tailings and the mine make this company one of the principal producers in Peru. Atacocha produced 58,200 metric tons of ore in 1944, averaging 14 percent zinc and 13.5 percent lead. By the end of 1944 the Volcan Mines was producing at the rate of 11,000 short tons a month. Production for the year was 66,677 short tons, averaging 17.65 percent zinc and 7.79 percent lead. The ore is milled under contract at the Mahr concentrator of Cerro de Pasco Copper Corp.

The Over-All Metals Agreement between the Peruvian Government and the United States Commercial Company was renewed August 8, 1944, effective as of July 1, 1944, when the previous agreement expired. The agreement provides for the purchase of zinc ores and concentrates. On December 6 the Peruvian Government was officially notified of an intended revision with respect to quantity and prices of metals and minerals to be purchased. Under the revision, the price of zinc in ores and concentrates (zinc content 55 percent or more) was reduced from 6 to 5 cents a pound f. o. b. steamer at Mollendo or Callao, less usual commercial smelting and treatment charges and deductions for metal losses and impurities.

Spain.—Output of zinc concentrates in 1944 was reported to be 57,590 metric tons (72,349 tons in 1943) and slab zinc 18,048 tons (19,200 tons in 1943). The lower output of concentrates was in part due to the interruption of traffic with Germany. The Reocin mine of Real Asturiana, which produced 80 percent of the total zinc concentrates, has large ore reserves and plans to expand production when equipment and power become available. The Arnao zinc smelter of this company produces all the zinc currently consumed in Spain. It is expected that the output of zinc will increase in the future and will be available for export as concentrates unless the domestic zinc smelter capacity is increased.

Sweden.—Zinc refining, from ore, was resumed in 1944 at the Trollhattan plant, at the rate of 5,000 metric tons a year. Restrictions on zinc were withdrawn in May 1944 as available supplies equaled the annual consumption level of 15,000 tons.

LEAD AND ZINC PIGMENTS AND ZINC SALTS

By HELENA M. MEYER AND ALETHEA W. MITCHELL

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GENERAL SUMMARY

Further improvement in sales of lead and zinc pigments was evident in 1944 over the generally low performance of this group in 1942. Conditions that applied to the earlier war years continued in 1944. In large part these conditions included outstanding war requirements for many items and shortages of essential crude materials and of manpower. For several years sales of the various pigments have not indicated actual demands for any of the items, because all the pigments have been influenced by manpower shortages and all have been affected in varying degree by shortages of necessary primary and subsidiary crude materials. The crude materials used for certain pigments have been in more abundant supply than for others; as a result, during the war some pigments have benefited—temporarily at least—at the expense of others. In 1944 war needs took a preponderant share of total sales of pigments, with the proportion increasing over the earlier war years. Pigments manufacturers continued to be hampered by restrictions on supplies of linseed and other drying oils and of slab zinc, and by limitations on containers. At the end of the year consumers of lead for the manufacture of pigments for civilian requirements faced sharp cuts in the quantities of this metal that could be used. Late in 1944 it was announced that, effective January 1, 1945, the quantities of fats and oils for use in the manufacture of protective coatings, coated fabrics, and floor coverings for civilian consumption were to be reduced from 70 to 60 percent of the average quantities for 1940 and 1941. For over a year, producers had been trying to build their civilian accounts as a safeguard against prospective cancellation of war orders, but these efforts did not come to fruition in 1944. Late in the year supplies of paint, varnish, and lacquer materials were bolstered by limited releases of surplus stocks

by some branches of the Government. As the year ended, however, war demands as a whole did not indicate that they had reached their maximum.

As in 1943, paint, varnish, and lacquer sales were at a new high record rate; the 1944 total was 9 percent above the former record. These data, compiled by the United States Department of Commerce, cover 680 establishments that contributed approximately 90 percent of the total value of the industry as reported in the Census of Manufactures for 1939. The value of sales totaled \$618,325,532 in 1944 compared with \$568,620,999 in 1943.

Trends in the supply-requirements positions for lead and zinc, as indicated in the chapter of this series for 1943, continued in 1944. These trends were toward larger supplies in relation to requirements for zinc and toward more stringent supplies of lead. This situation is explained, in part, by the fact that lead is a less-obvious war metal than zinc. As a consequence, more generous allowances of this metal had been made available for civilian use, and in addition encouragement had been given in the early part of the war to substitution of lead for some metals in relatively smaller supply. Improvement in the zinc situation continued into the third quarter of 1944, and this movement was accompanied by a tendency to lessen the restrictions on zinc. Meanwhile, despite the fact that stocks of lead dropped severely in 1944, ample supplies of metal were available to pigment makers until late in the year. The fourth quarter of 1944, which brought military disappointments, caused an abrupt revision of Government viewpoint regarding war requirements, called for larger war orders along many lines, and removed ideas of further allocations for civilian requirements. Not only were all moves toward greater allowances of zinc discontinued, but controls on lead were strengthened markedly by a revision of War Production Board Order M-38 in December and by further revision in January 1945. The revised lead order and other orders that affect the pigments covered by this report are discussed later.

Record-breaking production and sales of titanium pigments, which normally compete for markets supplied by lead and zinc pigments, were established in 1944, but even the increased amounts made available fell far short of supplying all requirements for expanded war and civilian needs. The Bureau of Mines is not at liberty to publish figures covering pigments of this class. The titanium group was subject throughout 1944 to the restrictions of Order M-353.

The feature of sales of lead and zinc pigments in 1944 was the high record quantities of litharge and red lead sold for battery manufacture. As a consequence of this outstanding consumption, both litharge and red lead established new high rates of sales in 1944—red lead by a narrow margin only because of a decline in sales for paint. The feature for 1943 was the large amount of zinc oxide sold for chemical warfare purposes. Sales for this use rose from none in 1942 to 22,000 in 1943, and continued upward to 28,000 tons in 1944. Increases of 13,500 tons in white lead and of 20,000 tons in leaded zinc oxide sold for paint in 1944, plus smaller gains for lithopone and basic lead sulfate, much more than offset the declines in red lead and zinc oxide sold for this purpose and reflected the record sales of paint, varnish, and lacquer materials in that year. Agricultural use of litharge reached a new high level in 1944 for the second year in succession. So far as

it is possible to ascertain, sales of zinc sulfate for agricultural purposes were also at a new record rate in 1944. For the most part, sales of pigments for the manufacture of ceramics rebounded somewhat from the low rates that prevailed in 1942 and 1943, but white lead did not share in the gains. Use of zinc oxide in the manufacture of rubber receded in 1944 from the relatively favorable rate that prevailed in 1943; distribution of litharge for this purpose, which had been gaining in recent years, also declined.

Two articles¹ concerning experiments in connection with war uses of paints were recently published. The Bureau of Standards² issued a report which is the third and last of the series covering the investigation of pretreatments and paints for protecting plain and galvanized steel surfaces against corrosion.

Salient statistics of the lead and zinc pigments industry of the United States, 1939-44

	1939	1940	1941	1942	1943	1944
Production (sales) of principal pigments:						
White lead (dry and in oil).....short tons..	98,429	80,562	113,000	83,639	76,167	85,726
Litharge.....do.....	89,518	89,841	122,280	91,513	113,091	138,203
Red lead.....do.....	39,976	42,200	53,838	48,369	53,378	53,972
Zinc oxide.....do.....	114,552	113,213	148,833	99,677	143,402	140,675
Leaded zinc oxide.....do.....	42,684	45,362	68,920	48,128	43,828	64,395
Lithopone.....do.....	142,759	151,802	176,642	137,320	135,723	142,905
Value of products:						
All lead pigments	\$35,485,000	\$32,628,000	\$46,572,000	\$39,393,000	\$41,897,000	\$46,601,000
All zinc pigments.....	28,794,000	28,747,000	39,210,000	30,785,000	36,260,000	39,288,000
Total.....	64,279,000	61,375,000	85,782,000	70,178,000	78,157,000	85,889,000
Value per ton received by producers:						
White lead (dry).....	\$138	\$137	\$147	\$160	\$163	\$163
Litharge.....	123	126	134	150	152	146
Red lead.....	140	141	161	171	171	164
Zinc oxide.....	117	118	125	138	137	139
Lead zinc oxide.....	114	114	118	129	132	132
Lithopone.....	73	67	71	79	79	78
Foreign trade:						
Lead pigments:						
Value of exports.....	\$715,000	\$594,000	\$1,228,000	\$957,000	\$1,439,000	\$1,387,000
Value of imports.....	10,000	14,000	12,000	4,000	3,000	6,000
Zinc pigments:						
Value of exports.....	925,000	1,585,000	3,525,000	2,741,000	2,737,000	2,016,000
Value of imports.....	280,000	46,000	22,000	8,000	5,000	1,500
Export balance.....	1,350,000	2,119,000	4,719,000	3,686,000	4,168,000	3,395,500

WAR AGENCY REGULATIONS

Lead was subject throughout the year to the limitations imposed by War Production Board Order M-38. This order was strengthened markedly in December by revisions that were expected to reduce civilian consumption to about 60 percent of the 1944 rate. A further revision on January 15, 1945, placed the lead pigments covered by this report (except litharge for storage-battery manufacture which remained under Order M-38) under a new chemicals order, M-384.

¹ Journal of the Franklin Institute, Exterior Paint on Temporary Army Buildings: Vol. 238, No. 6, December 1944, p. 455.

The Paint Industry Magazine, Paint, Its Durability and Use Under Field Conditions: Vol. 60, No. 1, January 1945, pp. 18 and 20.

² National Bureau of Standards, Building Materials and Structures, Painting Steel: Rept. BMS102, Oct. 16, 1944.

The sweeping M-384 order restricted the quantities of lead that could be put into process in any calendar quarter for the manufacture of basic carbonate of white lead to not more than 15 percent of that put into process in the first 6 months of 1944, and for leaded zinc oxide to 25 percent of the white lead (not lead content) put into process during the entire year 1944. Lead used in various products, such as insecticides, was similarly affected. The red lead that could be put into process in any calendar quarter in the production of paints, varnishes, and lacquers (including paste red lead) for civilian uses was limited to not more than 30 percent of the amount of pigment (not the lead content) similarly used in the first 6 months of 1944. The white lead that could be put into process in any calendar quarter for the foregoing purposes (including paste white lead) was restricted to 8 percent of the quantity of white lead (not the lead content) used in the base period. Ceramics manufacture for civilian uses was limited to 25 percent of the amounts of lead consumed in the base period. In each case there was the option to use 1,000 pounds per quarter if that quantity were greater than the stated measure. The order also placed inventory restrictions on white-lead consumers who were covered by it. White lead is defined in the order as meaning either basic carbonate of white lead or basic sulfate of white lead.

Zinc metal is controlled by War Production Board Orders M-11 and M-11-b. Consumption restrictions on zinc were liberalized during the year, as was indicated in the summary section of this report, but the tendency to ease the covering orders disappeared following military disappointments in the fall of 1944. Zinc oxide (lead-free) is subject to Order M-11-a, which was amended June 16 to add laboratory reagent chemicals, cellulose nitrate plastics, vulcanized fiber, and toilet soap to the list of permitted uses. The revised order also specified the type of paint in which lead-free oxide could be used. Leaded zinc oxide, which had escaped control until then, was placed under Order M-11-a in an amendment dated February 17, 1945. Order M-128, which referred to zinc sulfide pigments but which had been inoperative, was revoked in June 1944. The titanium pigments order, M-353, was amended to include zinc sulfide pigments, effective July 1, 1944. Thus priority ratings of AA-2 or higher were required for the purchase of all of these pigments; lower ratings were ineffective, with the exception of material needed to fill orders for the armed services, in which case such orders had to be accompanied by the certification set forth in M-353. The last order was amended in November to provide that only those rated orders that are accompanied by military certification would be treated as valid and filled as preferred orders.

POSTWAR OUTLOOK

The inability of pigments manufacturers to increase the civilian share of their business in 1943 and 1944 probably merely raised the amounts of these products that will have to be supplied after the war. Trigg² stated that deferred maintenance jobs, most of which will require paint, have been estimated as high as \$30 billions. He said that he felt justified in predicting a rapidly expanding future for the paint, varnish, and lacquer industry because:

² Trigg, Ernest T., *After War—What?!*: Paint Industry Mag., vol. 59, No. 11, November 1944, pp. 368-370.

In the first place, we have no reconversion problems. With reasonably speedy victory over Germany already assured and with victory over Japan in much clearer prospect than seemed likely before Germany's impending collapse, we are fully equipped for a head start without necessity of awaiting the final victory in the Pacific theater of war, while many other industries will have to reconvert their factory operations and cannot get started in new production for a considerable time to come. However, no matter what other industries do, they will need our products for practically any activities in which they engage.

As civilian production gains headway in catching up with the great backlog of deferred civilian needs, the demands upon the paint industry may be expected to surpass the records achieved in the peak war years.

The expected gain in postwar production of automobiles until pent-up requirements are filled was outlined in the report of this series for 1943. This gain and increases in production of other civilian equipment retarded by the war will call for pigments for finishes, storage batteries, rubber, and other items that are large pigment users. Railroads will need large supplies of pigments, as pointed out by Trigg in the article already cited, to rehabilitate rolling stock, stations, bridges, and other properties and equipment. He indicated also that a large merchant marine and the biggest Navy in the world will provide a large postwar market for pigments. The pigments export market for the purposes itemized could provide a postwar outlet for very large tonnages.

There seems to be little question regarding the size of postwar requirements for pigments. The main question concerns the proportions of the market that different pigments will supply. In this connection, the prewar shifts from certain pigments to others are expected to continue in postwar years.

PRODUCTION

Previous reports of this series have indicated that sales are a better guide to activity in the pigments industry than production because complete data are not available on stocks and materials classified as production of one item are sometimes disposed of under another classification. Moreover, pigments produced under one classification at a plant are sometimes employed at a plant of another company for blending into another pigment in the lead and zinc group. The Bureau of Mines attempts to eliminate all possible duplication and to tabulate products only in the form in which they enter final use as pigments. Thus the quantities of basic lead sulfate and zinc oxide that are blended to make leaded zinc oxide are omitted, except as leaded zinc oxide. Duplication caused by other blending, which is on a considerably smaller scale, is also avoided insofar as possible. Pigments consumed by the producing companies, however, to make products beyond those covered by this report—that is, paint, storage batteries, and other articles—are considered as sales.

The value of lead and zinc pigments in 1944 totaled \$85,889,000, a gain of 10 percent over 1943; it was the largest since 1929 and exceeded 1941 by a narrow margin.

LEAD PIGMENTS

As in 1943, litharge and red lead made the best showings of the pigments covered by this report; sales of both items were at higher levels than ever before, being 22 and 1 percent, respectively, larger than in

1943 and 13 and less than 1 percent above the previous records established by both classes in 1941. White lead sales have not maintained the pace set by most other pigments. Although they gained 13 percent over 1943 they were far below the records for most earlier years since before 1900. In 1944 the value of lead pigments sold gained 11 percent over 1943 and were 44 percent above the annual average for the prewar period 1935-39. The zinc total, meanwhile, was larger by 8 and 46 percent, respectively. The average values received by producers for litharge and red lead were reduced in 1944 as compared with 1943. As there was no reduction in average unit quotations for these two classes of pigments, the declines must be explained by shifts in delivery points of portions of the sales. The producers' values refer to values at plants.

Lead pigments sold by domestic manufacturers in the United States, 1943-44

Pigment	1943			1944		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Basic lead sulfate or sublimed lead:						
White.....	4, 752	\$700, 592	\$147	5, 253	\$765, 566	\$146
Blue.....	845	120, 102	149	1, 080	147, 255	136
Red lead.....	53, 378	9, 136, 015	171	53, 972	8, 840, 306	164
Orange mineral.....	79	19, 736	250	284	70, 154	247
Litharge.....	113, 091	17, 146, 672	152	138, 203	20, 207, 218	146
White lead:						
Dry.....	39, 525	6, 441, 908	163	46, 466	7, 570, 239	163
In oil.....	36, 642	8, 326, 458	227	39, 260	9, 000, 291	229

* Weight of white lead only but value of paste.

Lead pigments sold by domestic manufacturers in the United States, 1940-44, in short tons

Year	White lead		Basic lead sulfate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
1940.....	30, 115	50, 447	5, 493	707	42, 200	137	89, 841
41.....	54, 689	58, 311	8, 739	1, 631	53, 838	246	122, 280
42.....	35, 865	47, 774	7, 229	1, 181	48, 369	128	91, 513
43.....	39, 525	36, 642	4, 752	845	53, 378	79	113, 091
1944.....	46, 466	39, 260	5, 253	1, 080	53, 972	284	138, 203

ZINC PIGMENTS AND SALTS

Leaded zinc oxide registered the largest percentage gain in 1944 of the pigments covered by this report, except for the small tonnage of orange mineral; sales of leaded zinc oxide increased 47 percent. Total sales of leaded zinc oxide in 1944 were exceeded only by the tonnage for 1941 and failed to equal that record by 7 percent. The quantity of zinc oxide (lead-free) sold had the largest percentage rise in 1943 (44 percent), but it declined 2 percent in 1944. Government control of this pigment during much of the war has tended to divert consumers to other pigments. Lithopone sales increased 5 percent in 1944, but the rate was not high as compared with most years between

1925 and 1941. Producers' average prices showed some variation in 1944 from 1943 levels, but these changes do not reflect revisions in average quoted prices.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1943-44

Pigment or salt	1943			1944		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide ¹	143,402	\$19,712,413	\$137	140,675	\$19,582,487	\$139
Leaded zinc oxide ¹	² 43,828	5,801,840	132	² 64,395	8,496,579	132
Lithopone.....	135,723	10,745,305	79	142,905	11,208,891	78
Zinc chloride, 50° B.....	53,707	² 2,777,998	² 52	(³)	(³)	(³)
Zinc sulfate.....	15,649	1,261,801	81	17,156	1,431,487	83

¹ Zinc oxide containing 5 percent or more lead is classed as leaded zinc oxide.

² Includes a small quantity containing less than 5 percent lead.

³ Revised figures. ⁴ Satisfactory data not available.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1940-44, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
1940.....	113,213	45,362	151,802	(¹)	11,937
1941.....	148,833	68,920	176,642	(¹)	19,201
1942.....	99,677	48,128	137,320	52,374	14,331
1943.....	143,402	² 43,828	135,723	53,707	15,649
1944.....	140,675	² 64,395	142,905	(³)	17,156

¹ Data not available.

² Includes a small quantity containing less than 5 percent lead.

³ Satisfactory data not available.

Figures covering zinc chloride for 1944 are not available because of the refusal of one company, believed to be large, to give reliable data.

Sales of zinc sulfate failed by 11 percent to equal the rate for 1941, but except for that year they were the highest on record.

CONSUMPTION BY INDUSTRIES

WHITE LEAD

Sales of this pigment, which declined in 1943, returned virtually to the 1942 level in 1944. Total sales for the dry and "in oil" varieties increased 13 percent in 1944, but amounted to only 84 percent of the annual average for the prewar 5-year period, 1935-39; they were not much more than half of the average for the period of high industrial activity in 1925-29. The dry class gained 18 percent compared with 7 for the "in oil" grade, and it has fared much better, on the whole, for many years.

By far the largest part of white lead sales is for consumption in the manufacture of paints, ordinarily over 90 percent entering this use; 93 percent was reported as having gone into paints in 1944. It is believed that a break-down of the Other class would raise the paint total. Sales of white lead for the manufacture of ceramics declined in 1944 against the trend for other pigments used for that purpose.

Production of white lead totaled 76,191 tons in 1944.

Distribution of white lead (dry and in oil) sales, 1940-44, by industries, in short tons

Industry	1940	1941	1942	1943	1944
Paints.....	73,137	100,665	76,837	66,441	79,948
Other.....	3,029	3,704	1,812	1,444	946
Total.....	4,396	8,631	4,990	8,282	4,832
	80,562	113,000	83,639	76,167	85,726

The Eagle-Picher Lead Co. commented on the difficult operating conditions in its report to stockholders, as follows:

The White Lead Division continues to face almost prohibitive operating conditions. Recent drastic reduction in the allocation of lead to the production of paint pigments, coupled with a long-standing limitation order on the use of linseed oil, has reduced the permitted production of this Division to a degree that definitely precludes any hope of profitable operation.

BASIC LEAD SULFATE

The chief use of this pigment is also in the manufacture of paint. Large quantities, likewise, are used annually as an intermediate step in the manufacture of leaded zinc oxide. The amount so used is not counted as finished basic lead sulfate but is covered in this report under the figures for leaded zinc oxide. As a component of leaded zinc oxide also it goes chiefly into paints. In 1944, 7,800 tons of basic lead sulfate were sold for use in the manufacture of leaded zinc oxide compared with 6,100 tons in 1943. Leaded zinc oxide makers reported having used 5,600 tons of basic lead sulfate in 1943; comparable data for 1944 are not available.

Production of basic lead sulfate totaled 4,605 tons in 1944.

Distribution of basic lead sulfate sales, 1940-44, by industries, in short tons

Industry	1940	1941	1942	1943	1944
Paints.....	5,583	9,285	7,733	4,802	5,496
Rubber.....	128	200	89	131	268
Storage batteries.....	4	8	-----	3	2
Other.....	475	877	588	661	567
	6,200	10,370	8,410	5,597	6,333

RED LEAD

Trade in red lead was heavy in 1944, and a new high record total for sales was established by a narrow margin over 1941. This pigment has enjoyed great activity in the war years largely because of its desirability as a construction paint. The paint use, however, took 19 percent less red lead in 1944 than in 1943—its peak year thus far—and storage-battery manufacture, which regularly consumes the principal tonnages, took its turn at establishing a new high rate in its demand for red lead. Total red lead sales were less than 1 percent above the previous record in 1941, but sales for storage-battery manufacture rose 10 percent above the 1941 peak.

Production of red lead totaled 53,398 tons in 1944.

Distribution of red lead sales, 1940-44, by industries, in short tons

Industry	1940	1941	1942	1943	1944
Storage batteries.....	26, 718	27, 405	23, 545	26, 616	30, 211
Paints.....	11, 949	20, 130	21, 017	22, 271	18, 074
Ceramics.....	1, 117	1, 593	939	622	878
Other.....	2, 416	4, 710	2, 868	3, 869	4, 809
	42, 200	53, 838	48, 369	53, 378	53, 972

ORANGE MINERAL

There was a noteworthy gain in sales of this small-tonnage pigment in 1944. With the increase, the principal use changed from the manufacture of ink to the manufacture of color pigments. The advance in 1944 was made over the smallest annual total since 1889.

Production of orange mineral amounted to 280 tons in 1944 contrasted with only 3 in 1943.

Distribution of orange mineral sales, 1940-44, by industries, in short tons

Industry	1940	1941	1942	1943	1944
Color pigments.....	18	26	7	8	205
Ink manufacture.....	51	98	93	49	56
Other.....	68	122	28	22	23
	137	246	128	79	284

LITHARGE

A new peak rate of sales of litharge for storage-battery manufacture in 1944 carried total sales of litharge to record heights; they were 22 percent higher than in 1943 and 13 percent above the previous peak in 1941, and they thus made the best showing of the pigments covered by this report. Battery manufacture took more than half of the total, a condition that has existed only once before, in 1932, since the Bureau of Mines began to collect data on distribution of sales; in 1932 total sales of litharge were only 80 percent of the amount sold for battery manufacture in 1944. In addition to the litharge used to make batteries, the storage-battery manufacturers themselves produce a black or suboxide of lead which they use as a substitute for litharge. The amount so used in 1944—61,000 tons—equaled the record tonnage for 1941 and was 1,000 tons above 1943. In 1944, 58,000 tons of pig lead were required to manufacture the suboxide, compared with 57,000 in 1943. Black oxide figures are not included in the Bureau of Mines totals for litharge. Insecticidal use of litharge also made a new high record for the second successive year in 1944, surpassing the previous peak of 1943 by 28 percent. Ceramics took 25 percent more litharge than in 1943. Other of the larger users of litharge, except oil refining, took less of the pigment in 1944 than in 1943, the decline for rubber contrasting with the uptrend of recent years. The drop in use in chrome chemicals is explained more by restricted allowances of chrome than of lead.

Production of litharge amounted to 146,900 tons in 1944 compared with 112,037 tons in 1943.

Distribution of litharge sales, 1940-44, by industries, in short tons

Industry	1940	1941	1942	1943	1944
Batteries.....	38,303	49,847	43,630	54,984	72,342
Chemicals.....	16,041	19,403	14,830	20,236	25,957
Paints.....	12,072	18,285	9,525	9,866	12,381
Zinc pigments.....	8,456	13,927	7,344	9,351	8,233
Other.....	6,876	6,749	4,771	5,227	5,608
Other.....	1,590	3,968	3,460	4,302	3,023
Other.....	3,003	3,165	3,423	3,453	2,988
Other.....	418	647	343	98	117
Other.....	3,082	6,289	4,187	5,574	7,554
	89,841	122,280	91,513	113,091	138,203

ZINC OXIDE

Sales of this pigment receded slightly in 1944 from the relatively favorable rate that prevailed in 1943, but owing to restrictions on its use the amount of sales in neither year can be taken as a guide to total consumption requirements. Consumption for chemical warfare purposes gained 27 percent over 1943 against the trend for rubber and paints, the other principal classes of use, and this use superseded paint as the second most important outlet. Zinc oxide used in the manufacture of rubber declined 12 percent, and that used for paint declined 16 percent. The decrease for rubber is explained by the smaller percentage use of zinc oxide for synthetic versus natural rubber. Leaded zinc oxide was taken for some paint needs where the lead-free grade would have been specified except for the restrictions thereon.

Production of lead-free oxide amounted to 152,366 tons compared with only 123,913 tons in 1943.

Distribution of zinc oxide sales, 1940-44, by industries, in short tons

Industry	1940	1941	1942	1943	1944
Rubber.....	70,979	90,429	52,717	67,898	59,518
Chemical warfare.....				21,801	27,686
Paints.....	23,268	30,304	23,122	29,852	24,999
For coverings and textiles.....	4,752	6,991	5,224	6,633	9,563
Chemicals.....	6,352	8,596	2,934	3,203	3,653
Other.....	7,862	12,513	13,680	14,015	15,256
	113,213	148,833	99,677	143,402	140,675

LEADED ZINC OXIDE

Sales of leaded zinc oxide rose more sharply as compared with 1943 than any other pigment covered by this report; they gained 47 percent and were second only to the record tonnage for 1941, being 7 percent less than in that year. The preponderant use is in the manufacture of paints. This pigment was not subject to allocation control in 1944 as was the lead-free class, which resulted in its use in certain instances where the lead-free class would normally have been specified. It will be noted that sales of lead-free zinc oxide for the manufacture of paints declined 16 percent in 1944. The figures for leaded zinc oxide include basic lead sulfate used in blending, as is indicated under Basic Lead Sulfate.

Leaded zinc oxide production totaled 64,432 tons in 1944 compared with 39,515 tons in 1943. The totals are broken down as follows (1943 revised data in parentheses): Over 5-35 percent lead, 52,022 (33,144) tons; over 35-50 percent, 8,364 (5,908) tons; and most of the remainder in both years, 5 percent or less.

Distribution of leaded zinc oxide sales, 1940-44, by industries, in short tons

Industry	1940	1941	1942	1943	1944
Paints.....	44,341	67,472	47,052	42,303	62,223
Rubber.....		1		42	119
Other.....	1,021	1,447	1,076	1,483	2,053
	45,362	68,920	48,128	43,828	64,395

LITHOPONE

The lithopone statistics in this report are given on the basis of ordinary lithopone sold as such plus the ordinary lithopone content of the high-strength product. This method of publication is used to conceal the operations of one company which always dominates the output of the high-strength product and is the only producer in some years. In 1944 three companies, operating four plants, produced high-strength lithopone, but one company made a negligible contribution to the total. Lithopone sales in 1944 were influenced by the historic peak in total sales of all paint, varnish, and lacquer materials, over three-quarters of the sales of this product regularly going into paint, varnish, and lacquer channels. It is significant that lithopone sales for paints rose somewhat less than total sales of paints, varnish, and lacquer materials, inasmuch as lithopone would naturally benefit from restrictions on sales of other pigments, such as zinc oxide and titanium dioxide. Floor coverings and textiles take the next-most important amounts of lithopone, and sales for this purpose dropped 8 percent in 1944. A separation of the quantities for 1944, based on somewhat incomplete data, indicate that 9,578 tons were for floor coverings and 5,168 for coated fabrics and textiles. Use of lithopone for the manufacture of paper has been gaining and amounted to 6,488 tons in 1944, compared with 4,043 tons in 1943, 3,423 in 1942, and 5,559 in 1941. The 1944 total is a peak rate since 1937, the first year for which separate figures for this use are available. The consumption of titanium dioxide for paper manufacture was also at a high rate in 1944, the gross weight of titanium pigments showing a peak rate since before 1935 (the first year for which separation is available) but the TiO_2 content lagging behind that for 1943 and the even higher total for 1941. Printing ink took a large amount of lithopone (1,216 tons) in relation to most other years since before 1936 (the period for which data are available); the total for 1941 (2,301 tons), however, was considerably above all other years since before 1936. Exports are included mainly under Other, but one company at least classifies part of its exports according to the end use.

Plant capacity for the production of lithopone was reported to total 155,000 tons in 1944 or relatively the same as the 157,000 tons for 1943.

Production of lithopone totaled 133,960 tons compared with 132,621 tons in 1943. Stocks were reduced in both years. The plant of the

Lake and Pigment Department of the American Cyanamid Co. (formerly United Color & Pigment Co.) produced no lithopone in 1944, and no production is planned there for the future.

Distribution of lithopone sales, 1940-44, by industries, in short tons

Industry	1940	1941	1942	1943	1944
Paints, etc.....	¹ 117,075	¹ 132,691	¹ 109,216	¹ 103,860	¹ 108,800
Floor coverings and textiles.....	18,738	21,114	15,775	15,999	14,746
Rubber.....	3,387	3,547	1,047	1,078	726
Other.....	12,602	19,290	11,282	14,786	18,633
	151,802	176,642	137,320	135,723	142,905

¹ Includes a quantity, not separable, used for printing ink.

There was little change in consumption of ordinary-strength lithopone in the manufacture of titanated lithopone (which usually contains about 15 percent TiO_2), as 8,300 tons were used in 1944 compared with 8,400 in 1943. Production of titanated lithopone totaled 9,800 tons in both years. The lithopone figures in the following table are included in the totals for ordinary lithopone in the preceding table.

Titanated lithopone produced in the United States and ordinary lithopone used in its manufacture, 1940-44, in short tons

Year	Titanated lithopone produced	Ordinary lithopone used	Year	Titanated lithopone produced	Ordinary lithopone used
1940.....	18,100	15,200	1943.....	9,800	8,400
1941.....	16,800	14,100	1944.....	9,800	8,300
1942.....	11,700	9,900			

ZINC SULFIDE

Only one company produced zinc sulfide in 1944, as in 1943 and 1942, and the Bureau of Mines is not at liberty to publish figures for this pigment.

ZINC CHLORIDE

The Bureau of Mines is unable to publish figures on zinc chloride because of the refusal of one company, whose output is reported to be large, to give reliable information.

ZINC SULFATE

Sales of zinc sulfate increased 10 percent in 1944 and were second only to those for 1941, being 11 percent below that year. Rayon usually accounts for the largest part of sales of zinc sulfate, and this use stood first in 1944 with what appeared to be the largest quantities on record for one year. A more precise break-down of the "Chemical" class for 1941, however, might easily place 1941 sales for rayon above the 1944 total. The agricultural use of zinc sulfate has been growing in recent years, and the indication that this use took record quantities of zinc sulfate in 1944 seems likely to be true. Zinc sulfate finds varied application in agriculture. Some of the ways in which it is used are: As a fungicide in a variation of Bordeaux mixture in which

zinc sulfate is used in place of copper sulfate; with lime to spray peach trees for bacterial spots; more extensively with lime as a safener when arsenate of lead is used as a spray; with lime as a spray on various trees to make up for zinc deficiencies in the soil; alone directly in the soil to make up for zinc deficiencies; alone as a spray where the foliage will stand it; and to a certain extent for weed eradication. The sharp rise in sales of zinc sulfate for paint and varnish processing in 1943 was more than counteracted in 1944. The use of zinc sulfate for the manufacture of glue continued its substantial decline in 1944.

Distribution of zinc sulfate sales, 1940-44, by industries, in short tons

Industry	1940	1941	1942	1943	1944
Rayon.....	3,649	5,170	3,149	4,537	5,954
Agriculture.....	2,366	3,038	4,123	3,329	4,974
Chemicals.....	2,151	5,555	2,595	1,642	1,459
Paints and varnish processing.....	1,509	1,422	1,917	2,439	1,330
Flotation reagent.....	241	312	355	1,282	1,131
Glue.....	320	1,203	750	635	293
Electroplating.....	348	502	219	187	278
Textile dyeing and printing.....	54	130	60	213	-----
Other.....	1,299	1,869	1,163	1,385	1,737
	11,637	19,201	14,331	15,649	17,156

RAW MATERIALS USED IN MANUFACTURE OF LEAD AND ZINC PIGMENTS AND ZINC SALTS

Figures covering the raw materials used in making pigments and salts were not available when the report of this series for 1943 was prepared. Data for 1943 are given below, and those for 1944 will appear in a subsequent report.

Lead pigments and zinc pigments and salts are manufactured from a variety of materials, including ore, refined metal, and such secondary materials as scrap and waste from various industrial processes. In 1943, 93 percent of the lead in pigments was derived from pig lead and 7 percent from ore. Of the lead in ore used to make leaded zinc oxide, about 10 percent was from foreign sources. The proportion for zinc pigments in 1943 was 78 percent from ore, 8 percent from slab zinc, and 14 percent from secondary materials; about 14 percent of the ore used was foreign.

Metal content of lead and zinc pigments produced by domestic manufacturers, 1942-43, by sources, in short tons

Source	1942		1943	
	Lead in pigments ¹	Zinc in pigments	Lead in pigments ¹	Zinc in pigments
Ore:				
Domestic.....	² 18,185	103,445	14,356	97,332
Foreign.....	707	9,636	1,168	15,220
Metal.....	206,680	8,252	202,783	11,752
Secondary material ³	2	21,663	-----	19,809
	² 225,574	142,996	218,307	144,113

¹ Includes also lead recovered in leaded zinc oxide.

² Revised figures.

³ Zinc ashes, skimmings, drosses, and old metal.

The following tables give the source of the metal used in the manufacture of each pigment and salt. Pig lead is employed exclusively, either directly or indirectly, in the manufacture of white lead, litharge, red lead, and orange mineral and is used also in the manufacture of basic lead sulfate. The lead content of leaded zinc oxide made from basic lead sulfate, which in turn was made from pig lead, is credited to pig lead in the table. Zinc oxide is the only pigment in which considerable slab zinc is used. Ore is employed in the manufacture of zinc oxide, leaded zinc oxide, lithopone, zinc sulfate, and basic lead sulfate. A substantial proportion of the zinc in lithopone and most of that in zinc chloride made in the United States are derived from secondary material. For a number of years before the United States entered World War II there had been a large increase in the quantity of secondary zinc used in the manufacture of zinc oxide. The scarcity of supplies of both metal and scrap caused the proportion of the total oxide made by the French process to drop sharply in 1942 and to continue low in 1943, despite the fact that the tonnages produced by that process rebounded somewhat in the latter year.

Lead content of lead and zinc pigments produced by domestic manufacturers, 1942-43, by sources, in short tons

Pigment	1942					1943				
	Lead in pigments produced from—				Total lead in pigments	Lead in pigments produced from—				Total lead in pigments
	Ore		Pig lead	Secondary material		Ore		Pig lead	Secondary material	
	Domestic	Foreign				Domestic	Foreign			
White lead.....			73,757		73,757			49,056		49,056
Red lead.....			45,228		45,228			48,499		48,499
Litharge.....			86,667		86,667			103,993		103,993
Orange mineral.....			81		81			3		3
Basic lead sulfate.....	4,760		827		5,587	4,165		1,007		5,172
Leaded zinc oxide.....	13,425	707	120	2	14,254	10,191	1,168	225		11,584
	18,185	707	206,680	2	225,574	14,356	1,168	202,783		218,307

¹ Revised figures.

Zinc content of zinc pigments and salts produced by domestic manufacturers, 1942-43, by sources, in short tons

Pigment or salt	1942					1943				
	Zinc in pigments and salts produced from—				Total zinc in pigments and salts	Zinc in pigments and salts produced from—				Total zinc in pigments and salts
	Ore		Slab zinc	Second- ary ma- terial ¹		Ore		Slab zinc	Second- ary ma- terial ¹	
	Domestic	Foreign				Domestic	Foreign			
Zinc oxide.....	74,289	313	8,247	5,585	88,434	70,069	10,314	11,752	7,164	99,299
Leaded zinc oxide.....	19,687	5,555	-----	328	25,570	15,666	2,551	-----	449	18,666
Lithopone.....	9,469	3,768	5	15,750	28,992	11,597	2,355	-----	12,196	26,148
Zinc sulfide.....	(²)	(²)	-----	-----	(²)	(²)	(²)	-----	(²)	(²)
Zinc chloride.....	-----	-----	10	11,777	11,787	-----	-----	11	11,765	11,776
Zinc sulfate.....	671	1,250	36	2,151	4,108	1,734	414	32	2,837	5,017

¹ These figures are higher than those shown in the report on Secondary Metals—Nonferrous because they include zinc recovered from byproduct sludges, residues, etc., not classified as purchased scrap material.

² Bureau of Mines not at liberty to publish.

PRICES

The total and average values reported by producers for lead and zinc pigments and zinc salts are given in the tables in the first part of this report. For most of the products covered there was little change in average prices received, but those for both red lead and litharge declined. The lower values for these two products can be explained only by variation in delivery points of portions of the total sales. Producers' values are reported on an f. o. b. plant basis. The ceiling prices established by the Office of Price Administration for the pigments and salts covered in this report, and likewise those for the metals lead and zinc were unchanged throughout 1944 at the levels that prevailed in 1943.

Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1941-44, in cents per pound

Product	1941	1942	1943	1944
Basic lead sulfate, or sublimed lead, less than carlots, barrels.....	6.50- 7.00	7.00- 7.75	7.50- 7.75	7.50- 7.75
White lead, or basic lead carbonate, dry, carlots, barrels.....	7.50	7.50- 8.25	8.25	8.25
Litharge, commercial, powdered, barrels.....	7.00- 8.25	7.35- 9.00	8.00- 9.00	8.00- 9.00
Red lead, dry, 95 percent or less, less than carlots, barrels.....	8.50- 9.25	8.75-10.00	9.50-10.00	9.50-10.00
Orange mineral, American, small lots, barrels.....	11.00-11.75	11.25-12.50	12.00-12.50	12.00-12.50
Zinc oxide:				
American process, lead-free, bags, carlots.....	6.50	7.25	7.25	7.25
American process, 5 to 35 percent lead, barrels, carlots.....	6.25- 6.75	7.00- 7.38	7.25- 7.38	7.25- 7.38
French process, red seal, bags, carlots.....	7.75	8.50	8.50	8.50
French process, green seal, bags, carlots.....	8.25	9.00	9.00	9.00
French process, white seal, barrels, carlots.....	9.00	9.75	9.75	9.75
Lithopone, ordinary, small lots, bags.....	4.10	4.50	4.50	4.50
Zinc sulfide, less than carlots, bags, barrels.....	8.00- 8.25	8.50- 8.75	8.50- 8.75	8.50- 8.75
Zinc chloride, works:				
Solution, tanks.....	2.25- 2.50	2.50	2.50	2.50
Fused, drums.....	4.25- 6.50	5.00- 6.50	5.00- 6.50	5.00- 6.50
Zinc sulfate, crystals, barrels.....	3.15- 4.40	3.65- 4.60	3.85- 4.60	3.65- 4.60

¹ Quotation was reduced to 3.65-4.40 cents per pound in the September 11 issue, which added "works", freight allowed," to the description.

FOREIGN TRADE⁴

The average annual value of foreign trade in lead and zinc pigments has remained relatively high during the war as compared with prewar levels. The principal trade is under the export classifications, no import item reaching \$30,000 in value in either 1943 or 1944. Lead pigments export values declined 4 percent in 1944 as compared with 1943 but were 142 percent above the average for the 5-year period 1935-39, whereas zinc export values declined 26 percent and were 275 percent above the prewar average. Total exports of both classes (lead and zinc pigments) in 1944, however, amounted to only 4 percent of the value of total production in the United States.

⁴ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Value of foreign trade of the United States in lead and zinc pigments and salts,
1943-44

	1943		1944	
	Imports	Exports	Imports	Exports
Lead pigments:				
White lead.....		\$844,992	\$4	\$572,848
Red lead.....	\$492	314,771		411,620
Litharge.....	574	266,839	400	386,685
Orange mineral.....		2,102		3,075
Other lead pigments.....	2,283	10,443	5,558	12,424
	3,349	1,439,147	5,962	1,386,652
Zinc pigments:				
Zinc oxide.....	4,821	1,070,286	1,261	902,292
Lithopone.....		1,637,217		1,106,430
Zinc sulfide.....		29,523	281	7,195
	4,821	2,737,026	1,542	2,015,917
Lead and zinc salts:				
Lead arsenate.....		375,465		501,478
Other lead compounds.....		(¹)		(¹)
Zinc chloride.....		57,390		47,133
Zinc sulfate.....	29,212	81,750	28,678	82,829
Other zinc salts and compounds.....	(¹)	22,087	(¹)	46,587
	29,212	536,692	28,678	678,022
Grand total.....	37,382	4,712,865	36,182	4,080,591

¹ Data not available.

Lead pigments and salts.—Imports of lead pigments are virtually nonexistent. White lead is the principal export item under this heading, with red lead and litharge following in order of importance among the pigments, and lead arsenate standing out among the salts. Shipments of white lead from the country declined 35 percent in 1944 following a comparatively high rate of exportation in 1943. Exports of all of the other items specified rose in 1944, but those for lead arsenate did not equal half of the 1941 rate.

Lead pigments and salts imported for consumption in the United States, 1940-44

Year	Short tons					Total value
	Basic carbonate white lead	Red lead	Litharge	Orange mineral	Lead compounds	
1940.....	2		(¹)	1		\$13,969
1941.....	2	3			17	\$15,367
1942.....		2	2		11	\$5,841
1943.....		4	1			\$3,349
1944.....	(¹)		1			\$5,962

¹ Less than 1 ton.

² Includes also suboxide of lead, n. s. p. f., as follows—1940: \$13,571 (71,148 pounds); 1941: \$11,694 (65,356 pounds); 1942: \$3,221 (13,228 pounds); 1943: \$2,283 (6,614 pounds); 1944: \$5,558 (19,842 pounds).

Lead pigments and salts exported from the United States, 1940-44

Year	Short tons						Total value
	White lead	Red lead	Litharge	Orange mineral	Sublimed lead	Lead arsenate	
1940-----	1,360	1,336	1,586	(¹)	(¹)	1,450	\$836, 230
1941-----	2,901	2,966	2,892	(¹)	(¹)	4,797	2,100, 335
1942-----	2,249	1,391	1,999	7	95	296	1,030, 472
1943-----	4,692	1,535	1,610	7	71	1,527	1,814, 612
1944-----	3,052	2,117	2,391	13	82	2,133	1,888, 125

¹ Not compiled on an annual basis before 1942.

Zinc pigments and salts.—Zinc sulfate is the principal import item under this class, but it amounted to only 542 tons in 1944, virtually the same as in 1943. Lithopone and zinc oxide are the principal products exported and their individual quantities largely exceed each of the lead classes. Exports were smaller in 1944 by 33 and 8 percent, respectively, and the virtually constant rates for 1943 and 1942 were below those for 1941. Principal zinc salts exported, shown separately on an annual basis for the first time in 1942, are zinc sulfate and zinc chloride. Available data are covered in the footnote to the second table that follows.

Zinc pigments and salts imported for consumption in the United States, 1940-44

Year	Short tons						Total value
	Zinc oxide		Lithopone	Zinc sulfide	Zinc chloride	Zinc sulfate	
	Dry	In oil					
1940	273	45	.....	(1)	19	245	\$54, 923
1941	122	11	(1)	1	.....	162	29, 835
1942	13	1	.....	1	.....	362	26, 390
1943	10	11	.....	.....	.....	546	34, 033
1944	(1)	5	.....	(1)	.....	542	30, 220

¹ Less than 1 ton.*Zinc pigments and salts¹ exported from the United States, 1940-44*

Year	Short tons		Total value	Year	Short tons		Total value
	Zinc oxide	Lithopone			Zinc oxide	Lithopone	
1940-----	3, 239	14, 298	\$1, 584, 667	1943-----	6, 019	17, 320	\$2, 898, 253
1941-----	8, 264	21, 527	3, 525, 386	1944-----	5, 511	11, 551	2, 192, 466
1942-----	6, 013	17, 036	2, 913, 595				

¹ Zinc salts not separately recorded on an annual basis before 1942.

² Includes also—1942: Zinc sulfide, \$6,328 (37,691 pounds); zinc chloride, \$42,674 (648,343 pounds); zinc sulfate, \$53,624 (1,025,554 pounds); other zinc salts and compounds, \$76,023 (519,458 pounds); 1943: Zinc sulfide, \$29,523 (78,387 pounds); zinc chloride, \$57,390 (751,861 pounds); zinc sulfate, \$51,750 (1,830,508 pounds); other zinc salts and compounds, \$22,087 (139,940 pounds); 1944: Zinc sulfide, \$7,195 (40,223 pounds); zinc chloride, \$47,133 (711,953 pounds); zinc sulfate, \$82,829 (2,027,201 pounds); other zinc salts and compounds, \$46,587 (167,474 pounds).

THE MINERAL INDUSTRY OF ALASKA

(MINE REPORT)

By H. FOSTER BAIN

SUMMARY OUTLINE

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GENERAL CONDITIONS

The demands for men and materials with which to wage World War II caused a major dislocation in Alaskan mining in 1944. The total value of the mineral output dropped to \$7,032,000,¹ substantially what it was at the beginning of this century. Gold mining, which has always been the leading mining industry, and which in 1906 yielded over a million ounces, decreased to approximately 50,000 ounces, the smallest yield since the historic discoveries of 1898. For the time being at least virtually all of the modern gold-mining industry, which has meant so much to Alaska, was wiped out, becoming a war casualty. Not all of this happened in 1944, but the nadir was reached in that year. The descent began early in the war when, in order to construct air bases, roads, and other war facilities, both men and equipment were moved almost bodily out of the mines and into the war-construction gangs. This was particularly upsetting to Alaskan economy as gold mining has long been the leading inland activity, and almost all of Alaskan industry away from the coast depends on the prosperity of the mines. It was a war sacrifice no State was called upon to make in like degree. It had, naturally, some compensations. The spending of great sums of money to create the new war facilities produced a flush of temporary prosperity, and some of the roads, air bases, and port facilities will be of permanent use. Not all will be permanent, as in the rush that the times demanded much temporary construction was necessary in some places, and some, perhaps, was not well-considered. Out of it all will have come a very great improvement in the facilities for communication and transportation which has long been among the most insistent needs of the Territory. This however does not alter the fact that the whole economy of the region was upset, and the reconstruction period is sure to be difficult and perhaps long.

The closing of the great Alaska Juneau mine—long famous as the world's greatest low-cost producer—which to the end of 1943 had added \$80,489,823 to the world's wealth in gold, silver, and lead, was a historic event of great magnitude, both in mining and in Alaska.

¹ For detailed table on Alaskan mineral production, see chapter of this volume on Statistical Summary of Mineral Production.

Whether, and if so when, this mine will be reopened means much in the future of the Territory. For well over half a century it has been true that any miner who was out of work and could make his way to Juneau could be sure of a job either in the Alaska Juneau or the Treadwell mines on Douglas Island across the channel, whose activities preceded those at Juneau. This was a fact of great social significance and also one that had an important effect in promoting the development of Alaska. Under wartime conditions and regulations it became impossible to operate the mine without continuous and increasing deficits, and so one of the great mines of the world was closed.

Many operations that were smaller and less famous but assured a living to resident Alaskans also closed. The big dredging enterprises managed to keep going, though on a very much reduced scale. The dredges themselves were not needed for war work, and the companies were not stripped of tools and equipment as completely as were smaller hand-operated properties, but even the dredge owners had their difficulties and losses. One of the first steps needed in restoration of the normal economy of the area will be a redistribution of picks and shovels, of caterpillars and bulldozers. Fortunately this has already begun. With completion of the defense construction projects these implements become surplus property and will be sold through the Reconstruction Finance Corporation. Local needs are to be given first consideration, and those who sold their equipment for Army use in time of need are to have priority in its repurchase. This should make possible a considerable resumption of mining in 1945.

Not all the mining industries in Alaska suffered as a result of the war. The Army needed fuel as well as men and equipment, so coal mining more than doubled its prewar output, yielding 352,000 short tons valued at \$2,369,000. Coal constituted the largest single element in Alaska's mineral production for the year. Although coal crops out widely over Alaska, significant coal mining has developed in only two fields—the Healy River in central Alaska and the Matanuska near Anchorage. Alaskan coals were formed in the Tertiary period and are characteristically high-volatile, low-heat-value fuels. In a few localities they have been altered incident to changes in the beds with which they are associated, becoming much better in quality and higher in value. In fact, coal of all grades, even the highest, is present and in places can be mined. Unfortunately the very processes that have improved the quality of the coal—the folding, bending, and breaking of the rocks incident to the operation of mountain-making forces or to intrusion of the sedimentaries by igneous rocks—have made it more difficult to mine the coal. The high-grade coals of Alaska, as in the Bering River and Matanuska fields, are folded, twisted, faulted, and so dislocated as to make mining difficult and expensive. To a considerable degree these difficulties become less troublesome as work on an individual property permits better understanding of the local structure, but nonetheless this condition constitutes a real handicap and adds permanently to the cost of mine development and operation.

When the war came the only operating coal mines were in the Healy River and Matanuska districts. All the other fields were marked by abandoned workings; and even the railroads, where extensions had been made to the mines, had been torn up. The Healy River field is capable of yielding great quantities of cheaply mined coal from thick beds cropping out near the Alaska Railroad, with which the mines are

collected by a spur. Unfortunately the coal is subbituminous and not of high grade, averaging but little over 9,000 B. t. u. It gets on the easily but is well-adapted to steam making and household heating, the principal uses in the interior.

In the Matanuska field two mines had survived among the numerous early mining ventures. One was the Eska, opened originally to supply fuel to the Alaska Railroad and owned by it. For some years the Eska mine had been closed, and in order to encourage private industry the railroad purchased its coal on contract, the Evan Jones mine being the principal producer. To meet the war demand the Eska mine was reopened so that the entire Evan Jones output would be available for Army and civilian use. An additional small mine was opened, but the fact that only a short-term demand could be foreseen prevented any large development. The market situation has prevented growth of coal mining in Alaska. The small population and the limited degree of local industrialization affords only a small domestic market. There has proved to be little opportunity to export coal, primarily because of the competition of petroleum. Indeed the latter is encroaching on the field for coal in Alaska itself.

Petroleum development in Alaska has been at a standstill now for some years. Far too little actual drilling has yet been done to prove or disprove the value of the several promising structures along the southern coast. Although seepages and other indications are known at a number of places, the drilling so far has indicated that any producing horizons of commercial importance, if present at all, will probably be at considerable depths. In the presence of other promising prospects requiring less money to explore, the major producing companies have not felt any strong urge to seek oil in Alaska. It may be present and in considerable quantities, but only the drill can tell. On the Arctic slope some progress is being made. A restudy of Naval Petroleum Reserve No. 4 led to the discovery of additional seeps and structures that seem to show promise. Drilling equipment was

Total value of mineral production of Alaska, 1880-1944¹

Year	Value	Year	Value	Year	Value
1880	\$6,826	1903	\$9,088,564	1926	\$17,606,890
1881	15,000	1904	9,627,495	1927	14,402,440
1882	23,000	1905	16,490,720	1928	14,024,489
1883	67,148	1906	23,501,770	1929	15,946,830
1884	72,000	1907	20,840,571	1930	13,707,235
1885	425,000	1908	20,092,501	1931	12,371,057
1886	540,000	1909	21,140,810	1932	11,526,387
1887	657,000	1910	16,875,226	1933	12,681,071
1888	667,181	1911	20,866,122	1934	19,578,971
1889	847,490	1912	22,732,947	1935	18,811,544
1890	873,276	1913	19,645,498	1936	23,737,714
1891	1,014,211	1914	19,177,051	1937	27,927,958
1892	1,019,493	1915	32,854,011	1938	28,796,753
1893	1,104,982	1916	48,521,513	1939	25,673,569
1894	1,339,332	1917	40,710,655	1940	28,724,221
1895	2,588,832	1918	28,217,407	1941	26,809,380
1896	2,885,029	1919	19,616,909	1942	20,094,260
1897	2,539,294	1920	23,396,114	1943	9,055,000
1898	2,329,616	1921	17,041,057	1944	7,032,000
1899	5,425,262	1922	19,506,610	Total	902,557,000
1900	7,995,209	1923	20,241,137		
1901	7,306,381	1924	17,361,834		
1902	8,475,813	1925	18,286,320		

¹Source of figures, as follows—1880-1910: Bulletins on Mineral Industry of Alaska, prepared and issued by Alaskan Branch of Geological Survey; 1911-44: Mineral Resources of the United States and Minerals Yearbook, prepared and issued by Geological Survey (1911-23) and Bureau of Mines (1924-44).

sent up there in 1944 and in part was moved inland in the winter of 1944-45. It is expected that drilling will be begun on the Colville River dome in 1945. Development of global aviation and emphasis on the shorter northern routes have given new significance to possible petroleum fields of the Arctic coast.

METAL PRODUCTION

The following tables show the mine production of gold, silver, copper, and lead in Alaska in 1940-44 and 1880-1944, in terms of recovered metals; the output of gold and silver in 1944, by types of operation; and the output of gold, silver, copper, and lead from amalgamation and cyanidation mills (with or without concentration equipment) in 1944, by regions.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ³	Zinc ³
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940.....	\$35.00	\$40.711+	\$0.113	\$0.050	\$0.063
1941.....	35.00	4.711+	.118	.057	.075
1942.....	35.00	4.711+	.121	.067	.093
1943.....	35.00	4.711+	.130	.075	.108
1944.....	35.00	4.711+	.135	.080	.114

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price includes bonus payments by Metals Reserve Company for overquota production.

⁴ \$0.71111111.

Gold and silver.—Placer and lode mines in 1944 yielded (in terms of recoverable metals) 49,296 ounces of gold valued at \$1,725,360, compared with 99,583 ounces valued at \$3,485,405 in 1943—a decline of 50 percent; and 13,362 ounces of silver valued at \$9,502, compared with 42,788 ounces valued at \$30,427 in 1943—a decline of 69 percent.

Mine production of gold, silver, copper, and lead in Alaska, 1940-44, and total, 1880-1944, in terms of recovered metals

Year	Gold (lode and placer)		Silver (lode and placer)	
	Fine ounces	Value	Fine ounces	Value
1940.....	755,970	\$26,458,950	191,679	\$136,305
1941.....	695,467	24,341,345	191,522	136,183
1942.....	487,621	17,066,735	119,704	85,123
1943.....	99,583	3,485,405	42,788	30,427
1944.....	49,296	1,725,360	13,362	9,502
1880-1944.....	25,788,530	615,613,152	19,738,522	14,040,723

Mine production of gold, silver, copper, and lead in Alaska, 1940-44, and total, 1880-1944, in terms of recovered metals—Continued

Year	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
1940	110,000	\$12,430	1,558,000	\$77,900	\$26,685,585
1941	144,000	16,992	1,324,000	75,468	24,569,998
1942	44,000	5,324	830,000	55,610	17,212,792
1943	54,000	7,020	400,000	30,000	3,552,852
1944	4,000	540	88,000	7,040	1,742,442
1880-1944	¹ 685,859	226,561,866	¹ 24,800	2,747,671	858,963,412

¹ Short tons.

Mine production of gold and silver in Alaska in 1944, by types of operation, in terms of recovered metals

Type of operation	Mines pro- ducing	Material treated	Gold			Silver			Total value
			Fine ounces	Percent of total		Fine ounces	Percent of total		
				1944	1943		1944	1943	
Low mines connected-bucket flotation Placers (hydraulic, drift min- ing, sluicing, etc.)	9 9 189	1 381,574 2 074,385 (¹)	15,685 26,280 7,331	32 53 15	58 19 23	9,170 2,423 1,769	60 18 13	88 5 7	\$555,496 921,523 257,843
Total, 1943	207 122	----- -----	49,296 99,583	100 -----	----- 100	13,362 42,788	100 -----	----- 100	1,734,862 3,515,832

¹ Short tons of ore.

² Cubic yards of gravel.

³ Includes all other types and sizes of placer operations.

⁴ Figures not available.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Alaska in 1944, by regions, in terms of recovered metals

Region	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Cook Inlet-Susitna	600	3,111	150	47	728	44	-----	-----
Copper River	40	17	4	-----	-----	-----	-----	-----
Kodiak Peninsula	40	35	10	1	6	4	-----	-----
Southeastern Alaska	379,644	8,010	2,143	160	2,350	6,521	4,000	88,000
Yukon River Basin	1,250	1,428	294	-----	-----	-----	-----	-----
Total, 1943	381,574	12,601	2,601	208	3,084	6,569	4,000	88,000
	1,481,644	47,623	10,041	1,168	9,719	27,408	18,192	400,000

Bullion of Alaska origin deposited at United States Assay Office, Seattle, Wash., during year ended Dec. 31, 1944, in fine ounces

Region	Gold	Silver	Region	Gold	Silver
Cook Inlet-Susitna	3,853	257	Southeastern Alaska	8,736	2,300
Copper River	2	-----	Yukon River Basin	15,156	2,002
Kodiak Peninsula	53	15			
Kuskokwim	2,969	251		45,976	6,666
Seward Peninsula	15,207	1,841			

The mining region showing the largest production of gold in 1944 was the Seward Peninsula, followed in order of greatest output by the Yukon River Basin, Southeastern Alaska, Cook Inlet, Kuskokwim Kenai Peninsula, Copper River, and Northwestern Alaska regions. The Southeastern Alaska region was the largest producer of silver.

The largest producing lode mine and the largest individual producer of gold and silver in the Territory in 1944 was the Alaska Juneau Gold Mining Co. mine at Juneau. This property, operating at a greatly reduced capacity, was shut down indefinitely on April 9, 1944, as the result of a manpower shortage and a War Labor Board decision to award a 14-cent wage increase to all company employees. The company mined 378,800 tons of ore during its 1944 operations and produced 9,712 ounces of gold, 8,454 ounces of silver, and 4,000 pounds of copper. The Cleary Hill Mines Co. operated its mine on Cleary Creek in the Fairbanks district under a lode-mine permit from the War Production Board and shipped bullion to the Seattle Assay Office. About 20 men were employed in the operation. The Alaska Pacific Consolidated Mining Co. mine in the Willow Creek district north of Wasilla, idle since August 8, 1943, was permitted to resume operations in May. The 1944 operation was limited to repair and development.

Placer mines produced about 68 percent of the production of gold and 31 percent of the silver from Alaska in 1944. There were 9 floating connected-bucket dredges in operation in the Territory in 1944, compared with 7 in operation in 1943. The United States Smelting, Refining & Mining Co., largest producer of gold in Alaska before the present conflict, obtained a permit from the War Production Board to operate two of its dredges at Fairbanks and one at Nome. About 30 men were employed at Fairbanks in thawing, sluicing, stripping, and dredging operations, and bullion was shipped to the Government assay office in Seattle (Wash.). The Nome dredge was put in condition for an early start in 1945. The Arctic Circle Exploration Co. employed about 50 men in its dredging operation at Candle in the Seward Peninsula region. Other large dredging operations in Alaska in 1944 were the North American Dredging Co. at Flat and the New York Alaska Gold Dredging Co. at Nyac. In addition, about 189 mines were being worked by other types of placer operation in 1944.

In all, the War Production Board has issued operating permits to about 70 placer-mining operators, the largest being the United States Smelting, Refining & Mining Co., the Arctic Circle Exploration Co., Livengood Placers, Inc., New York Alaska Gold Dredging Co., Inland Dredging Co., and Wallace Porter. Permits also have been issued to 8 or 10 lode-mine operators, including the Cleary Hill Mines Co., Alaska Pacific Consolidated Mining Co., and the Alaska Empire Gold Mining Co. The employment of about 775 men so far has been authorized by the Board. Other small mines did not require a license to operate.

Copper.—Copper production in 1944 came from Southeastern Alaska and totaled 4,000 pounds valued at \$540, compared with 54,000 pounds valued at \$7,020 in 1943—a decline of 93 percent in quantity. The average weighted yearly price per pound for copper,

including bonus payments by the Metals Reserve Company for overquota production, advanced from \$0.130 in 1943 to \$0.135 in 1944.

Lead.—The lead production in Alaska in 1944 also came from the Southeastern region, where it was produced by the Alaska Juneau so long as that mine operated. Total output was 88,000 pounds valued at \$7,040, compared with 400,000 pounds valued at \$30,000 in 1943—a decline of 78 percent in quantity. The yearly weighted price of lead advanced from \$0.075 in 1943 to \$0.080 in 1944, which includes bonus payments by the Metals Reserve Company for overquota production. Lead ore occurs at a number of places in the Territory, but difficulties of transportation have so far prevented its being mined.

Platinum metals.—As heretofore, production of platinum in 1944 came mainly from the floating dredge and dragline operations of the Goodnews Bay Mining Co. on Salmon River in the Goodnews Bay district. Output was at a rate somewhat higher than in 1943. A small quantity of gold was recovered as a byproduct.

Mercury.—Contrary to the record for the States, production of mercury in Alaska in 1944 showed some gain. This was due to continuation of purchases by the Metals Reserve Company beyond January, at which time purchases closed in the States. Virtually all the 1944 output was made in the first half of the year, and no mine was active at the year end. The New Idria Alaska Quicksilver Mining Co. operated the Red Devil mine at Sleitmut through the winter of 1943-44, but operations ceased in June 1944. The Decoursey Mountain Quicksilver Mining Co. operated its mine and retort on Decoursey Mountain until June and shipped mercury to the Metals Reserve Company stock pile.

Tin.—In 1944, for the first time in many years, no tin ore seems to have been produced in Alaska although a small amount was received—presumably the result of earlier operations. The principal producer shut down in 1942, and with the virtual stoppage of gold placer mining, from which a small amount of tin concentrate was recovered as a byproduct, tin production ceased for the present.

Chromite.—The Chrome Queen Mining Co., only chromite producer in Alaska in 1944, resumed operations in the Kenai Peninsula region and shipped several lots of chromite to the Metals Reserve Company ore-purchasing depot at Jakolof Bay. Having completed the contract, the company closed the mine in August for an indefinite period.

Tungsten.—The J. H. Scott Co., operating in the Hyder district, made a small shipment, as did the Stepovich mine near Fairbanks. Some of the Stepovich ore yields a 60-percent WO_3 product, and there are various prospects that offer possibility of becoming producers.

Antimony.—The Stampede mine in the Kantishna district was idle in 1944, and the only producer was Ernest Maurer on Slate Creek, who shipped 73 tons of 48-percent ore.

Other metals.—No production of iron ore, manganese, molybdenum, or vanadium was recorded from Alaska in 1944. Diamond drilling on the Kasaan Peninsula in the winter of 1943-44 revealed over 1,000,000 tons of iron-copper ore. Results obtained to date are encouraging, and indications are that further exploration will yield favorable results. Drilling in Southeastern Alaska revealed the presence of considerable tonnages of nickel-copper ores, but the grade was low.

NONMETALLIC PRODUCTION

In 1944, for the first time in the history of Alaskan mining, the value of the yield of nonmetals exceeded that of the metals, amounting to \$3,700,000 as compared with \$3,300,000 for the metals. The two totaled but \$7,000,000, compared with a prewar total of \$28,724,000 as in 1940. The reasons for this great decline have already been discussed.

Coal.—Coal output in 1944 totaled 352,000 tons valued at \$2,369,000 as compared with 289,232 tons and \$1,842,708 in 1943. There are reasons for believing that this production exceeded consumption for the year and that some 30,000 tons went into stock piles. It seems probable that the output in 1945 will be less than in 1944, as the active construction projects of the Army and Navy have largely been completed, and that hereafter only the fuel needed for operation of the new bases will be called for. As already indicated, the recorded output came only from the Matanuska and Healy River fields. Small quantities probably were dug out for strictly local use elsewhere, but at present the only significant mining is in these two districts. A new small mine, the Buffalo, came into operation in the Matanuska field.

Sand and gravel.—Based on reports from the Alaska Road Commission, National Park Service, Public Roads Administration, and the Army and Navy, it is estimated that in 1944 the output amounted to 712,496 short tons valued at \$499,269.

Stone.—Production of crushed stone in Alaska in 1944 was considerable, but figures can not be released at this time.

Asbestos.—A deposit of tremolite asbestos has been developed in the Dahl Creek area, Kobuk River district, and small shipments were made in 1944. The material is of good quality. An important use is for making chemical filters.

An unusual occurrence of asbestos appears on Lemesurier Island, Southeastern Alaska. Lenses 6 to 8 inches wide of "mountain leather," consisting of matted fibers resembling buckskin, occur in bed seams and cross joints in limestone. It has been identified as paligorskite, an amphibole asbestos. Mountain leather has appeared heretofore chiefly as museum specimens. As this Alaskan occurrence may afford a small tonnage it may be possible to put it to commercial use.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA

(MINE REPORT)

By G. E. WOODWARD AND PAUL LUFF

SUMMARY OUTLINE

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SUMMARY

Despite a decrease of 7 percent from \$121,212,902 in 1943 to \$113,094,806 in 1944 (see fig. 1), the total value of gold, silver, copper, lead, and zinc in terms of recoverable metals from Arizona mines exceeded that for the same five metals produced in 1944 in any other State. In both quantity and value the output of gold, silver, and copper decreased substantially, but the quantity and value of lead and zinc increased. The total value of the gold was \$3,925,670—a 33-percent loss from 1943; silver, \$3,124,650—a 23-percent loss; and copper, \$96,741,810—an 8-percent loss. The value of the lead was \$2,673,120—a 30-percent gain; and zinc, \$6,629,556—a 56-percent gain. The value of the gold production represented 3 percent of the State total value, silver 3 percent, copper 86 percent, lead 2 percent, and zinc 6 percent. The value of the metals recovered from copper ore was \$101,163,271 in 1944 (\$112,020,217 in 1943), or 89 percent of the State total. The output of lead in 1944 was the largest in any year in the history of the State, and the production of zinc exceeded the record output of 1943.

Production of gold, silver, copper, lead, and zinc in Arizona in 1944 was affected by several factors: A serious shortage of labor, which was the primary cause of a loss in output of gold, silver, and copper; the completion in January of the work of increasing the capacity (from 25,000 to 45,000 tons of ore a day) of the copper concentrator and smelter at the Morenci property of the Phelps Dodge Corporation; the large output of zinc-lead ore from the Copper Queen property at Bisbee and the San Xavier mine near Sahuarita; the loss of about 4,000,000 pounds of copper a month during the last quarter of the year from the Inspiration property at Inspiration, caused by a fire on October 1 which destroyed the electrolytic tank house; the fire on Labor Day which destroyed the shaft, gallows frame, ore bins, and other structures at the zinc-lead property of the Mammoth-St. Anthony Limited at Tiger; the suspension of operations in July at the Duquesne zinc-lead-copper mine near Patagonia by the Callahan Zinc-Lead Co.; and the closing in October of the zinc-lead property of the Tennessee-Schuylkill Corporation at Chloride.

The effect of the labor shortage on the domestic copper industry was especially acute owing to the fact that Arizona has seven large

copper-producing districts and six copper smelters. Copper production in Arizona reached the highest rate (about 72,800,000 pounds a month) in March and dropped to the lowest rate (about 46,800,000 pounds) in November.

Since the inauguration in February 1942 of the Government premium price plan, the base price of copper, lead, and zinc has remained unchanged; copper has been \$0.12 a pound, lead \$0.065 a pound (New York), and zinc \$0.0825 a pound. The basic Government policy of premium payments for overquota production remained in force throughout 1944.

Considerable assistance was given to mine operators in Arizona in 1944 by the Grazing Service of the United States Department of the Interior, which built access roads to various properties. About 48 applications for roads were investigated, of which 20 were approved and 28 disapproved; the estimated cost of building the approved roads was \$138,700. Most of the roads approved for construction were to copper, zinc-lead, and zinc-copper properties. Some access roads also were constructed by the Indian Service and the Forest Service. The Federal Bureau of Mines, in cooperation with the Federal Geological Survey, did considerable work in 1944 exploring and testing various properties throughout the State. Most of this work was drilling test holes at the San Manuel copper deposit near Tiger in Pinal County, the Apache iron deposit near Cibecue in Navajo County, the Amargosa molybdenum deposit near Sahuarita in Pima County, the Bullard copper mine near Aguila in Yavapai County, and the Christmas copper mine near Winkelman in Gila County. Assistance was given to the small mine operators in Arizona by the Department of Mineral Resources (State of Arizona), and the Reconstruction Finance Corporation made numerous mine development (class B) loans and accessibility (class C) loans to Arizona operators in 1944.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ³	Zinc ³
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940.....	\$35.00	\$0.711+	\$0.113	\$0.050	\$0.063
1941.....	35.00	¢.711+	.118	.057	.075
1942.....	35.00	¢.711+	.121	.067	.093
1943.....	35.00	¢.711+	.130	.075	.108
1944.....	35.00	¢.711+	.135	.080	.114

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price includes bonus payments by Metals Reserve Company for overquota production.

¢\$0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1940-44, and total, 1880-1944, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1940	1,024	276	21,572,175	294,807	\$10,318,245	7,075,215	\$5,031,264
1941	805	184	25,491,794	315,392	11,038,720	7,498,260	5,332,096
1942	515	163	33,920,731	253,651	8,877,785	7,064,467	5,023,621
1943	274	19	36,630,788	171,810	6,013,350	5,713,889	4,063,210
1944	226	17	35,900,641	112,162	3,925,670	4,394,039	3,124,650
1880-1944			(1)	10,711,912	262,412,075	285,860,433	212,093,250

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1940	562,338,000	\$63,544,194	26,532,000	\$1,326,600	30,912,000	\$1,947,456	\$82,167,759
1941	652,634,000	77,010,812	31,276,000	1,782,732	32,986,000	2,473,950	97,638,310
1942	786,774,000	95,199,654	29,544,000	1,979,448	37,044,000	3,445,092	114,525,600
1943	806,362,000	104,827,060	27,454,000	2,059,050	39,354,000	4,250,232	121,212,902
1944	716,606,000	96,741,810	33,414,000	2,673,120	58,154,000	6,629,556	113,094,806
1880-1944	10,601,666	3,138,023,740	327,260	39,211,268	193,579	33,467,681	3,685,208,014

¹ Figures not available.

² Short tons.

Gold and silver produced at placer mines in Arizona, 1940-44, in fine ounces, in terms of recovered metals

Year	Sluicing ¹		Drift mining		Dredges				Total	
					Dry-land ²		Dragline floating ²			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1940	1,625	207	646	41	1,186	464	2,784	396	6,241	1,108
1941	976	125	77	5	824	717	10,054	1,358	11,931	2,205
1942	885	176			35	5	1,916	217	2,836	398
1943	315	14	4						319	14
1944	242	90							242	90

¹ Includes placer sands treated by dry concentration plants.

² A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

Gold.—The output of recoverable gold in Arizona in 1944 was 112,162 fine ounces—a 35-percent decrease from 1943. Gold from siliceous ores (chiefly dry and siliceous gold ore) declined 15,093 ounces or more than 58 percent, that from copper ore 32 percent, and that from zinc-lead ore nearly 25 percent. Gold from placers declined from 319 to 242 ounces. The Copper Queen (Bisbee) branch of the Phelps Dodge Corporation continued to be the leading gold producer in Arizona, although its output declined 35 percent from that in 1943;

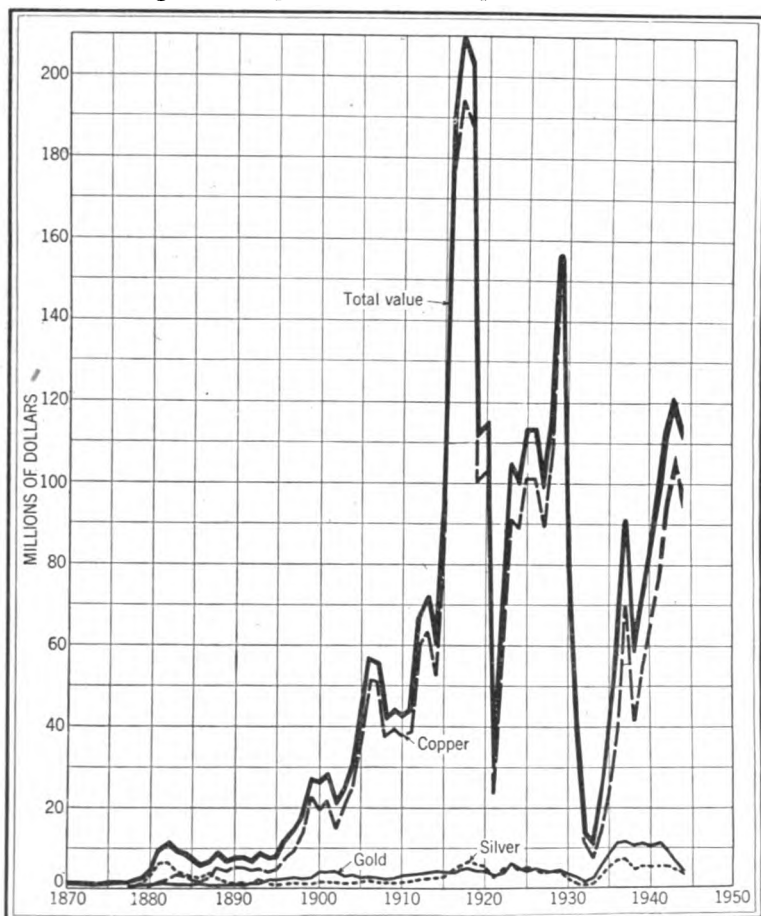


FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in Arizona, 1870-1944. The value of lead and zinc has been less than \$2,000,000 annually, except in a few years.

it was followed by the New Cornelia mine in Pima County, the United Verde mine in Yavapai County, the Magma mine and the Mammoth-St. Anthony Limited property (both in Pinal County), the Morenci branch of the Phelps Dodge Corporation in Greenlee County, and the Iron King mine in Yavapai County; these seven properties produced 84 percent of the State total gold. Copper ore yielded 81 percent of the State total gold, siliceous ores nearly 10 percent, zinc-lead ore more than 6 percent, and lead ore and zinc-copper ore nearly all the remainder. The chief gold-producing districts in Arizona were the

Warren (38,401 ounces), Ajo (29,020), Verde (8,620), Pioneer (Superior) (6,630), Old Hat (6,389), Big Bug (5,409), and Copper Mountain (Morenci) (5,389 ounces).

Silver.—The output of recoverable silver in Arizona in 1944 was 4,394,039 fine ounces—a 23-percent decrease from 1943. The chief decreases were 1,260,601 ounces in silver from copper ore, 193,711 ounces from siliceous ores, and 24,753 ounces from zinc-lead-copper ore; however, the output of silver from zinc-lead ore increased 151,170 ounces. Copper ore yielded 71 percent of the State total silver, zinc-lead ore 18 percent, siliceous ores 4 percent, zinc-copper ore nearly 4 percent, lead ore 2 percent, and zinc-lead-copper ore 1 percent. The Phelps Dodge Corporation continued to be the chief silver producer in Arizona, although its output was nearly 32 percent less than in 1943; its four properties (Copper Queen, Morenci, New Cornelia, and United Verde) produced 68 percent of the State gold output, nearly 59 percent of the silver, and 58 percent of the copper. Other large silver producers in Arizona in 1944 were the Magma, Iron King, Trench-Flux, San Xavier (Eagle-Picher Mining & Smelting Co.), Shattuck Denn, and Castle Dome properties. The chief silver-producing districts were the Warren (1,550,506 ounces), Verde (589,538), Pioneer (Superior) (386,429), Ajo (319,320), Copper Mountain (Morenci) (281,153), Big Bug (229,490), Globe-Miami (187,612), Harshaw (176,438), and Pima (149,265 ounces); nearly 49 percent of the State total silver came from the Warren and Verde districts, but the output from these districts decreased 1,148,400 ounces from 1943.

Copper.—Arizona has been the outstanding producer of copper in the United States since 1907 except in 1909, when Montana held first place. The output of recoverable copper in Arizona in 1944 was 716,606,000 pounds—an 11-percent decrease from 1943. The Copper Mountain (Morenci) district, with an output of 213,851,000 net pounds of copper, was the leading copper-producing area in the State; it was followed by the Globe-Miami district with 190,609,200 pounds, Ajo with 92,500,000, Warren (Bisbee) with 65,366,000, Mineral Creek (Ray) with 54,904,200, Verde (Jerome) with 52,429,000, and Pioneer (Superior) with 25,444,800 pounds. Marked decreases in copper output were recorded in each of these districts except the Copper Mountain (Morenci), where the output increased 45,156,600 pounds; these seven districts contributed 97 percent of the State total copper. Copper ore and its products yielded 709,366,574 pounds of copper, as follows: 31,069,798 tons of copper ore treated by concentration yielded 75 percent; 1,087,707 tons of copper ore shipped crude to smelters, 14 percent; and 3,131,360 tons of copper ore leached and 14,814 tons of cement copper (from mine-water precipitates and underground leaching operations), 11 percent. The Morenci branch of the Phelps Dodge Corporation was again the largest copper producer in Arizona in 1944; it was followed in order by the New Cornelia branch of the Phelps Dodge Corporation, Inspiration, Copper Queen, Miami, Ray (Kennecott Copper Corporation), United Verde, Castle Dome, Magma, and Bagdad properties.

Lead and zinc.—The output of recoverable lead in Arizona in 1944 was 33,414,000 pounds—the largest in any year in the history of the State and 22 percent more than in 1943. The output of recoverable zinc was 58,154,000 pounds—a 48-percent increase over the record output of 1943. The full calendar year operations at the zinc-lead

ore body of the Copper Queen mine at Bisbee and the San Xavier mine near Sahuarita accounted for most of the State increase in lead and zinc output; such operations at the Copper Queen mine were begun in November 1943 and at the San Xavier mine in September 1943. About 21 percent of the State total lead and 28 percent of the zinc came from mines at Bisbee in Cochise County, 26 percent of the lead and 22 percent of the zinc from Pinal County, nearly 15 percent of the lead and 18 percent of the zinc from mines near Sahuarita in Pima County, and 15 percent of the lead and 11 percent of the zinc from mines near Patagonia in Santa Cruz County; most of the remaining lead and zinc output came from Yavapai, Mohave, and Gila Counties. About 83 percent of the total lead and 80 percent of the total zinc came from zinc-lead ore; nearly all the rest of the lead came from lead ore, siliceous ores, zinc-lead-copper ore, zinc-copper ore, and zinc ore; and all the rest of the zinc came from zinc-copper ore, zinc-lead-copper ore, and zinc ore. The Mammoth-St. Anthony Limited property at Tiger was the leading producer of lead in the State in 1944; it was followed in order by the Copper Queen mine at Bisbee, San Xavier mine near Sahuarita, Trench-Flux group near Patagonia, Iron King mine at Humboldt, Tennessee mine at Chloride, and Arizona Lead Co. property near Yuma. The principal producer of zinc in the State in 1944 was the Copper Queen mine at Bisbee; it was followed in order by the San Xavier, Magma, Iron King, Mammoth-St. Anthony Limited, Trench-Flux, Duquesne, and Tennessee properties.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1944, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Cochise.....	17	1	38,593	\$1,350,755	1,571,362	\$1,117,413
Coconino.....	5	.....	72	2,520	7,134	5,073
Gila.....	26	.....	4,395	153,825	202,950	144,320
Graham.....	3	.....	25	875	2,323	1,652
Greenlee.....	5	1	5,640	197,400	335,499	238,577
Maricopa.....	13	2	1,399	48,965	12,967	9,221
Mohave.....	24	.....	1,616	56,560	62,834	44,682
Pima.....	24	.....	29,177	1,021,195	518,701	368,854
Pinal.....	15	.....	13,686	479,010	513,668	365,275
Santa Cruz.....	18	.....	181	6,335	242,910	172,736
Yavapai.....	60	12	16,915	592,025	871,287	619,562
Yuma.....	16	1	463	16,205	52,404	37,265
Total, 1943.....	226	17	112,162	3,925,670	4,394,039	3,124,650
	274	19	171,810	6,013,350	5,713,889	4,063,210

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Cochise.....	65,792,000	\$8,881,920	7,481,000	\$598,480	16,384,000	\$1,867,776	\$13,816,344
Coconino.....	1,776,000	239,760	9,000	720	.....	.....	248,073
Gila.....	191,552,000	25,859,520	1,033,000	82,640	819,000	93,366	26,333,671
Graham.....	29,000	3,915	361,000	28,880	616,000	70,224	105,546
Greenlee.....	213,852,000	28,870,020	.....	.....	.....	.....	29,305,987
Maricopa.....	309,000	41,715	297,000	23,760	.....	.....	123,661
Mohave.....	1,423,000	192,105	1,585,000	126,800	2,366,000	269,724	689,871
Pima.....	95,052,000	12,832,020	4,965,000	399,600	10,474,000	1,194,036	15,815,705
Pinal.....	80,904,000	10,922,040	8,712,000	696,960	12,741,000	1,452,474	13,915,759
Santa Cruz.....	1,056,000	142,560	5,053,000	404,240	6,627,000	755,478	1,481,349
Yavapai.....	64,546,000	8,713,710	2,709,000	216,720	8,127,000	926,478	11,068,515
Yuma.....	315,000	42,525	1,179,000	94,320	.....	.....	190,315
Total, 1943.....	716,606,000	96,741,810	33,414,000	2,673,120	58,154,000	6,629,556	113,094,806
	806,362,000	104,827,060	27,454,000	2,059,050	39,354,000	4,250,232	121,212,002

Gold and silver produced at lode mines in Arizona in 1944, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Cochise	775,604	38,502	1,571,362
Cocope	12,852	72	7,134
Graham	13,442,855	4,305	202,950
Greenlee	4,299	25	2,323
Maricopa	11,328,018	5,636	335,499
Mohave	13,799	1,391	12,967
Yavapai	45,925	1,616	62,834
Yuma	6,550,670	29,177	518,701
Chino	2,278,469	13,686	513,668
Imperial	75,163	181	242,910
San Diego	1,349,287	16,685	871,266
San Juan	23,700	454	52,335
Total 1943	35,900,641	111,920	4,393,949
Total 1944	36,630,788	171,491	5,713,875

Gold and silver produced at placer mines in Arizona in 1944, by counties, in fine ounces, in terms of recovered metals

County	Sluicing ¹		Drift mining		Dredges				Total	
					Dry-land ²		Dragline floating ³			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Cochise	1	-----	-----	-----	-----	-----	-----	-----	1	-----
Cocope	4	-----	-----	-----	-----	-----	-----	-----	4	-----
Yavapai	8	-----	-----	-----	-----	-----	-----	-----	8	-----
Imperial	220	21	-----	-----	-----	-----	-----	-----	220	21
Yuma	9	69	-----	-----	-----	-----	-----	-----	9	69
Total 1943	242	90	-----	-----	-----	-----	-----	-----	242	90
Total 1944	315	14	4	-----	-----	-----	-----	-----	319	14

¹Includes placer sands treated by dry concentration plants.

²A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; secondary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-dredge."

MINING INDUSTRY

The mining of copper ore, by far the most important part of the mining industry in Arizona, was seriously handicapped in 1944 by a shortage of labor, which became so acute by fall that some of the large producers of copper ore had to curtail the mining of ore 40 percent. The total production of ore of all classes dropped from the record of 36,630,788 tons in 1943 to 35,900,641 tons in 1944. The output of copper ore was 35,288,865 tons—a 2-percent loss from 1943; zinc-lead ore, 337,940 tons—a 29-percent gain; zinc-copper, 96,603 tons—a 9-percent gain; lead ore, 27,101 tons—a 34-percent loss; and zinc-lead-copper, 18,578 tons—a 31-percent loss. The output of siliceous ores was 129,086 tons compared with 186,185 tons in 1943—a 31-percent decline. Of the State total ore, 35,147,844 tons (98 percent) was copper ore mined in the Globe-Miami, Copper Mountain (Moenkopi), Ajo, Mineral Creek (Ray), Warren (Bisbee), Eureka (Hillside), Verde (Jerome), and Pioneer (Superior) districts; 97 percent of the State total zinc-lead ore was mined in the Big Bug, Warren (Bisbee), Yuma, Harshaw, Old Hat (Oracle), and Wallapai (Chloride) districts; all the zinc-lead-copper ore came from two properties—one in the

Patagonia district and the other in the Big Bug district; 92 percent of the zinc-copper ore came from one mine in the Pioneer (Superior) district; nearly 61 percent of the lead ore from one property in the Castle Dome district; and 58 percent of the zinc ore from one mine in the Pima district. More than 78 percent of the State total gold ore came from three properties—in the Old Hat (Oracle), Owens, and Bullard districts; 76 percent of the gold-silver ore from one property in the Copper Mountain (Morenci) district; and 70 percent of the silver ore from one mine in the Ash Peak district. Mining operations at two open pits—Ajo and Morenci—produced a total of 17,722,944 tons of copper ore.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Arizona in 1944, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore.....	37	56,008	9,260	15,946	655,469	667,141	-----
Dry and siliceous gold-silver ore....	9	61,520	1,207	57,819	1,412,630	9,057	-----
Dry and siliceous silver ore.....	13	11,558	324	118,733	11,195	27,097	-----
Copper ore.....	59	129,086	10,791	192,498	2,079,294	703,295	-----
Lead ore.....	113	35,288,865	91,113	3,106,402	709,366,574	10,395	-----
Zinc ore.....	52	27,101	1,400	81,894	76,017	4,092,423	-----
Zinc-copper ore.....	7	2,468	14	8,126	41,181	74,310	588,222
Zinc-lead ore.....	8	96,603	1,036	160,191	2,481,653	332,683	8,712,863
Zinc-lead-copper ore.....	25	337,940	7,300	791,728	1,995,704	27,680,631	46,493,393
Zinc-lead-copper ore.....	2	18,578	266	53,110	565,577	511,263	2,359,522
Total, lode mines.....	¹ 226	35,900,641	111,920	4,393,949	716,606,000	33,414,000	58,154,000
Total, placers.....	17	-----	242	90	-----	-----	-----
Total, 1944.....	243	35,900,641	112,162	4,394,039	716,606,000	33,414,000	58,154,000
Total, 1943.....	293	36,630,788	171,810	5,713,889	806,362,000	27,454,000	39,354,000

¹ Includes 295 ounces recovered from underground mine-water precipitates.

² Includes 79,003,481 pounds recovered from ore leached and mine-water precipitates.

³ A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

⁴ Includes 117,416,341 pounds recovered from ore leached and mine-water precipitates.

METALLURGIC INDUSTRY

Of the 35,900,641 tons of ore produced in 1944 in Arizona, 31,543,180 tons (88 percent) were treated at concentration plants; 3,131,360 tons (9 percent) at a leaching plant; 30,443 tons (less than 0.1 percent) at cyanidation and cyanidation-concentration mills; and 1,195,658 tons (3 percent) were shipped crude to smelters. No ore was treated at amalgamation mills in Arizona in 1944, but 30,443 tons of siliceous material were treated (144,338 tons in 1943) at cyanidation and cyanidation-concentration plants; 2,950 tons of material were treated at two straight cyanidation plants in 1944 compared with 24,700 tons at four plants in 1943; the most important of these plants was that at the Mammoth-St. Anthony Limited property at Tiger, and this plant closed July 31.

Ore treated at concentration plants in 1944 comprised chiefly 31,069,798 tons of copper ore, 337,684 tons of zinc-lead ore, 96,603 tons of zinc-copper ore, 18,578 tons of zinc-lead-copper ore, and 16,634 tons of lead ore. Copper ore from the Miami property was treated by

a combination of leaching and concentration, and copper ore from the Inspiration mine was treated by straight leaching and by leaching and concentration. The large copper-concentration plants at Ajo (25,000-ton-a-day), Clarkdale (2,100-ton), Hayden (10,000-ton), Miami (18,000-ton), Inspiration (18,000-ton), and Superior (850-ton) were operated continuously in 1944 but at a much lower rate than in 1943, whereas those at Morenci (45,000-ton), Castle Dome (10,000-ton), and Hillside (Bagdad) (2,500-ton) were operated at a higher rate than in 1943. The copper-leaching plants at Inspiration (9,000-ton) and Miami (3,000-ton) and the copper smelters at Clarkdale, Douglas, Hayden, Miami, Morenci, and Superior were operated also at a reduced rate with the exception of the smelter at Miami. The rated capacity of charge of the six copper smelters was as follows: Clarkdale, 1,400,000 tons per year; Douglas, 1,600,000; Hayden, 360,000; Miami, 360,000; Morenci, 600,000; and Superior (Magma), 210,000 tons. The Phelps Dodge Corporation reported that the Douglas smelter operated throughout the year and smelted a total of 925,431 tons (1,162,830 tons in 1943) of new material. Furnace operations varied between a straight calcine charge and a mixed calcine and raw charge. Extensive furnace repairs and a shortage of receipts late in the year prevented utilization of the maximum furnace capacity. The smelter at Clarkdale treated 518,627 tons of new material in 1944 compared with 875,953 tons in 1943. After the first 2 months of the year smelting operations were confined to one reverberatory furnace and two converters. The Morenci smelter treated 422,320 tons of new material in 1944 compared with 443,373 tons in 1943; operating conditions remained difficult throughout the year, and metallurgy was handicapped. Labor shortages prevented full utilization of smelting facilities, and surplus concentrates were shipped to the Douglas smelter. The 20-ton smelter at Tiger is the only lead smelter in Arizona; it operated exclusively on concentrates from the mill of Mammoth-St Anthony Limited until July 31, when operations ceased. Nearly all the lead concentrates produced at mills in Arizona in 1944 were shipped to the smelter at El Paso, Tex., and all the zinc concentrates were shipped to smelters at Amarillo, Dumas, and Corpus Christi, Tex., and Bartlesville and Henryetta, Okla.

The following tables give details of the treatment of all ores produced in Arizona in 1944.

Mine production of metals in Arizona in 1944, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Old tailings, and current						
tailings cyanided	29,561	656	1,767			
Concentrates smelted	1,216,175	60,710	2,372,667	537,638,149	30,290,131	57,755,263
Smelted	1,195,658	50,554	2,019,220	99,964,370	3,123,869	398,737
Slurry precipitates smelted	14,814		295	121,211,424		
Slurry ore leached	3,131,360		57,792,057			
Slurry		242	90			
		112,162	4,394,039	716,606,000	33,414,000	58,154,000
Total, 1944		171,810	5,713,889	806,362,000	27,454,000	39,354,000

Distribution as follows: Cochise County, 600,000 pounds; Gila County, 9,252,711 pounds; Greenlee County, 2,414,400 pounds; Pinal County, 8,380,913 pounds; and Yavapai County, 563,400 pounds.

Treated by straight leaching at 1 plant in Gila County.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Arizona in 1944, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Total: 1944	(1)								
1943	4	21	3	1	3	44		200	

CYANIDATION MILLS

Maricopa	2,700	58	185						
Mohave	250	8	398						
Pinal	27,493	590	1,184	882	5,152	2,408	480	637,255	
	30,443	656	1,767	882	5,152	2,408	480	637,255	
Total, 1943	144,338	4,755	25,782	10,000	16,529	109,698	74,574	2,361,960	2,850,000
Grand total: 1944		656	1,767	882	5,152	2,408	480	637,255	
1943		4,776	25,785	10,001	16,532	109,742	74,574	2,362,160	2,850,000

¹ None treated at amalgamation mills in 1944.

Mine production of metals from concentrating mills in Arizona in 1944, by counties, in terms of recovered metals

County	Material treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Cochise	61,664	24,272	767	135,021	668,758	7,006,770	16,360,000
Gila	10,242,996	173,960	4,229	188,187	120,812,410	816,900	819,000
Graham	4,017	967	10	1,570	18,502	343,588	616,000
Greenlee	11,265,526	450,993	5,100	271,275	209,325,000		
Maricopa	2,092	213	238	605	2,181	30,449	
Mohave	26,379	5,090	852	55,104	163,657	1,533,028	2,366,000
Pima	6,524,904	182,857	29,078	479,783	93,671,295	4,961,340	10,474,000
Pinal	2,197,151	187,863	6,254	423,920	65,436,035	6,790,300	12,741,000
Santa Cruz	67,599	11,352	83	217,337	732,436	4,557,811	6,627,000
Yavapai	1,134,470	176,532	8,943	583,472	46,807,395	2,532,690	7,752,263
Yuma	16,382	1,174	4	13,985		1,080,000	
Total, 1943	31,543,180	1,215,293	55,558	2,370,259	537,637,669	29,652,876	57,755,263
	30,986,501	1,410,676	72,483	2,391,975	553,158,314	22,296,686	36,392,425

*Gross metal content of concentrates produced from ores mined in Arizona in 1944,
by classes of concentrates smelted*

Class of concentrates	Concen- trates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Bar gold.....	70	115	86	1,077	-----	-----
Copper.....	1, 117, 844	50, 305	1, 623, 805	550, 062, 381	103, 951	11, 852, 294
Lead.....	24, 995	8, 679	569, 719	1, 285, 440	25, 012, 006	4, 486, 060
Lead-copper.....	5, 217	524	161, 558	634, 864	5, 434, 546	1, 067, 836
Zinc.....	62, 117	2, 158	246, 113	1, 177, 681	4, 160, 924	64, 738, 075
Zinc-copper.....	105	-----	290	27, 900	11, 400	106, 800
Iron-lead.....	63	20	663	1, 044	11, 140	65, 987
Iron.....	5, 764	2, 385	13, 685	22, 852	137, 229	616, 499
Total, 1943.....	1, 216, 175	64, 186	2, 615, 919	553, 213, 239	34, 880, 196	82, 933, 351
	1, 420, 677	91, 958	2, 685, 036	569, 902, 646	27, 490, 203	63, 568, 850

*Mine production of metals from Arizona concentrates shipped to smelters in 1944,
in terms of recovered metals*

BY COUNTIES

	Concen- trates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Cochise.....	24, 272	767	135, 021	668, 758	7, 006, 770	16, 360, 000
Gila.....	173, 960	4, 229	188, 187	120, 812, 410	816, 900	819, 000
Graham.....	987	10	1, 570	18, 502	343, 588	616, 000
Greenlee.....	450, 993	5, 100	271, 275	209, 325, 000	-----	-----
Maricopa.....	213	238	605	2, 181	30, 449	-----
Mohave.....	5, 090	852	55, 104	163, 657	1, 533, 028	2, 366, 000
Pima.....	182, 857	29, 078	479, 783	93, 671, 295	4, 961, 340	10, 474, 000
Pinal.....	188, 745	11, 406	426, 328	66, 436, 515	7, 427, 555	12, 741, 000
Santa Cruz.....	11, 352	83	217, 337	732, 436	4, 557, 811	6, 627, 000
Yavapai.....	176, 532	8, 943	583, 472	46, 807, 395	2, 532, 690	7, 752, 263
Yuma.....	1, 174	4	13, 985	-----	1, 080, 000	-----
Total, 1943.....	1, 216, 175	60, 710	2, 372, 667	537, 638, 149	30, 290, 131	57, 755, 263
	1, 420, 677	89, 015	2, 501, 717	553, 232, 888	24, 658, 846	39, 242, 425

BY CLASSES OF CONCENTRATES

	Concen- trates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Bar gold.....	70	115	86	1, 035	-----	-----
Copper.....	1, 117, 844	47, 550	1, 477, 735	535, 233, 506	31, 058	-----
Lead.....	24, 995	8, 679	569, 719	1, 068, 032	23, 018, 782	-----
Lead-copper.....	5, 217	524	161, 558	533, 380	5, 000, 888	-----
Zinc.....	62, 117	1, 428	148, 931	760, 420	2, 132, 461	57, 600, 373
Zinc-copper.....	105	-----	290	22, 300	-----	95, 500
Iron-lead.....	63	20	663	990	10, 138	59, 390
Iron.....	5, 764	2, 385	13, 685	18, 486	96, 804	-----
Total, 1943.....	1, 216, 175	60, 710	2, 372, 667	537, 638, 149	30, 290, 131	57, 755, 263

Gross metal content of Arizona crude ore shipped to smelters in 1944, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	23, 975	3, 274	11, 670	694, 020	30, 756	27, 000
Dry and siliceous gold-silver	61, 070	1, 208	57, 927	1, 492, 064	145, 373	204, 834
Dry and siliceous silver	11, 558	324	118, 733	12, 001	35, 206	1, 140
Copper	1, 087, 707	44, 470	1, 758, 477	105, 142, 819	15, 957	4, 753, 291
Lead	10, 467	1, 344	67, 803	93, 609	3, 257, 213	853, 764
Zinc	625	7	4, 006	29, 980	41, 300	399, 667
Zinc-lead	256	3	2, 084	13, 093	34, 243	147, 830
Total, 1943	1, 195, 658	50, 630	2, 020, 700	107, 477, 586	3, 560, 048	6, 387, 526
	1, 778, 019	77, 863	3, 189, 299	146, 411, 820	3, 244, 680	149, 186

Mine production of metals from Arizona crude ore shipped to smelters in 1944, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Cochise	713, 940	37, 825	1, 436, 046	64, 523, 242	474, 230	24, 000
Cocoonino	12, 852	72	7, 134	1, 776, 000	9, 000	
Gila	68, 499	166	14, 763	3, 694, 822	216, 100	
Graham	282	15	753	10, 498	17, 412	
Greenlee	62, 492	536	64, 224	2, 112, 600		
Maricopa	9, 007	1, 095	12, 177	306, 819	266, 551	
Mohave	19, 296	756	7, 332	1, 259, 343	51, 972	
Pima	25, 766	99	38, 918	1, 380, 705	33, 660	
Pinal	53, 825	1, 690	86, 156	7, 086, 572	1, 284, 445	
Santa Cruz	7, 564	98	25, 573	323, 564	495, 189	
Yavapai	214, 817	7, 752	287, 794	17, 175, 205	176, 310	374, 737
Yuma	7, 318	450	38, 350	315, 000	99, 000	
Total, 1943	1, 195, 658	50, 554	2, 019, 220	99, 964, 370	3, 123, 869	398, 737
	1, 778, 019	77, 700	3, 186, 373	135, 712, 771	2, 795, 154	111, 575

BY CLASSES OF ORE

Dry and siliceous gold	23, 975	3, 274	11, 670	652, 958	17, 287	
Dry and siliceous gold-silver	61, 070	1, 188	57, 135	1, 412, 530	317	
Dry and siliceous silver	11, 558	324	118, 733	11, 195	27, 097	
Copper	1, 087, 707	44, 414	1, 757, 789	97, 775, 170	10, 395	
Lead	10, 467	1, 344	67, 803	75, 867	2, 994, 573	
Zinc	625	7	4, 006	25, 500	40, 565	291, 782
Zinc-lead	256	3	2, 084	11, 150	33, 635	106, 955
Total, 1943	1, 195, 658	50, 554	2, 019, 220	99, 964, 370	3, 123, 869	398, 737

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1944, by county and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Cochise County:													
California.....	1	---	1,011	17	---	17	2,759	---	2,759	72,000	---	---	\$12,277
Cochise.....	2	---	4,351	---	---	---	1,447	---	1,447	229,200	---	---	42,858
Dos Cabezas and Travis.....	1	---	373	36	---	36	1,111	---	1,111	61,200	---	95,500	8,952
Golden Rule (Dragon).....	1	---	256	---	---	---	1,194	---	1,194	1,800	---	---	8,978
Hartford (Huachuca Mountains).....	2	1	241	8	---	9	1,004	---	1,004	2,000	1,300	74,500	8,380
Swisshelm.....	1	---	1,232	55	---	55	5,012	---	5,012	1,000	25,100	44,500	26,555
Tombstone.....	2	---	1,265	30	---	30	5,445	---	5,445	4,000	270,900	---	18,712
Turquoise.....	4	---	1,502	45	---	45	4,884	---	4,884	64,800	158,500	5,000	19,108
Warren.....	3	---	765,373	38,401	---	38,401	1,550,566	---	1,550,566	65,366,000	32,200	24,000	13,670,454
Cocconino County:													
Havasupai Canyon.....	1	---	9	---	---	---	159	---	159	---	9,000	---	833
Jacob Canyon and Warm Springs.....	3	---	10,820	71	---	71	5,490	---	5,490	1,529,000	---	---	212,804
Kabito Plateau.....	1	---	2,013	1	---	1	1,485	---	1,485	247,000	---	---	34,436
Gila County:													
Banner and Dripping Springs.....	7	---	26,227	131	---	131	13,282	---	13,282	969,000	836,000	819,000	296,991
Globe-Miami.....	15	---	13,416,152	4,242	---	4,242	187,612	---	187,612	190,609,200	197,000	---	26,029,885
Green Valley.....	2	---	96	7	---	7	630	---	630	2,200	---	---	2,425
Pioneer (Pinal Mountains).....	1	---	99	15	---	15	1,419	---	1,419	6,600	6,425	---	3,350
Summit.....	1	---	349	---	---	---	7	---	7	25,000	---	---	---
Graham County:													
Aravaipa.....	2	---	4,117	12	---	12	2,302	---	2,302	10,000	361,000	616,000	103,726
Lone Star.....	1	---	182	13	---	13	21	---	21	10,000	---	---	1,820
Greenlee County:													
Ash Peak.....	2	---	8,410	247	---	247	54,346	---	54,346	1,000	---	---	47,426
Copper Mountain (Morenci).....	3	---	11,319,608	5,359	---	5,359	281,153	---	281,153	213,851,000	---	---	29,238,431
San Francisco River.....	1	---	---	---	4	4	---	---	---	---	---	---	140
Maricopa County:													
Ellsworth (Harqua Hala) 1.....	1	---	68	13	---	13	7	---	7	3,200	---	---	892
New River.....	1	---	2,670	38	---	38	661	---	661	190,000	---	---	27,450
Osborn.....	3	---	6,752	883	---	883	11,551	---	11,551	112,400	274,000	---	76,213
Sunflower.....	1	---	1	---	---	---	---	---	---	---	---	---	70
Vulture.....	5	2	2,711	68	8	76	208	---	208	200	900	---	2,907
White Piencho 2.....	1	---	1	9	---	9	---	---	---	---	---	---	315
Wickenburg.....	1	---	1,616	378	---	378	540	---	540	3,200	22,100	---	15,814

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1944, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Mohave County:													
Cedar Valley.....	2	1	2,334	13			2,295		2,295	136,600	18,000	275,000	\$53,318
Cottonwood.....	1		101	9			28		28	3,200			767
Hacks Canyon.....	1		86				149		149	8,200			1,213
Indian Secret (White Hills)	1		250	8			398		398				563
Owens.....	5		9,574	670		670	2,094		2,094	269,800			61,362
San Francisco (Oatman, Goldroad, Katherine, Vivian)	1		1	21		21	14		14				745
Wallapai.....	13		33,579	895		895	57,856		57,856	1,005,200	1,567,000	2,091,000	571,903
Pima County:													
Ajo.....	1		6,454,071	29,020		29,020	319,320		319,320	92,500,000			13,730,272
Amole.....	2		466	24		24	450		450	400	24,900		3,206
Baboquivari.....	1		947	21		21	2,731		2,731	25,400			6,106
Cerro Colorado.....	1		73	1		1	6,030		6,030	800	5,200		4,847
Helvetia (Rosemont)	10		20,240	51		51	11,025		11,025	1,070,800	67,100	134,000	174,827
Old Hat.....	2		15,337	12		12	10,177		10,177	655,400			96,271
Pima (Sierritas, Papago, Twin Buttes)	5		54,784	37		37	149,265		149,265	504,000	4,890,400	10,340,000	1,745,471
Roskrige and Waterman.....	1		4,656	10		10	18,009		18,009	290,400			52,787
Silver Bell.....	1		96	1		1	1,094		1,094	3,800	7,400		1,918
Pinal County:													
Bunker Hill.....	2		842				249		249	110,000			15,027
Dripping Springs.....	1		19	7		7				1,200			167
Martinez Canyon.....	1		423				1,274		1,274	800			11,078
Mineral Creek.....	3		1,898,821	675		675	50,386		50,386	54,904,200	125,800		7,471,322
Mineral Hill.....	2		56	3		3	52		52	1,200	3,900		616
Old Hat.....	1		71,424	6,377		6,377	75,174		75,174	425,000	8,322,000	5,041,000	1,374,401
Pioneer (Superior)	3		306,664	6,630		6,630	386,429		386,429	25,444,800	290,300	7,700,000	4,840,316
Saddle Mountain.....	1		49	1		1	90		90	3,200			331
Summit.....	1		171				7		7	13,600			1,841
Santa Cruz County:													
Hardsaw.....	4		50,747	76		76	176,438		176,438	133,000	4,423,000	4,101,000	967,436
Oro Blanco.....	1		546	71		71	11,551		11,551	800			10,807
Pajarito.....	1		55				547		547		2,200		37,638
Palmetto.....	1		4,162							278,800			438,222
Patagonia.....	5		19,391	22		22	52,671		52,671	633,900	586,200	2,522,500	6,481
Tyndall.....	6		262	12		12	1,703		1,703	9,800	41,600	3,500	
Yavapai County:													
Agua Fria.....	4		11,917	78		78	1,710		1,710	626,400			88,510
Big Bend.....	4		112,441	5,460		5,460	229,469		229,469	468,600	2,488,700	7,587,000	1,479,783
Black Canyon.....	5		259	79		79	1,049		1,049	1,800	1,400	5,000	4,436
Black Hills.....	2		129	1		1	782		782	3,000			4,996
Black Rock.....	2		101	2		2	59		59	8,400			1,246

Blue Tank.....	1	3	7,000	603	4	2,949	2,949	240,000	1,540	1,000	140
Butler (Piters).....	4		11	8	8	21	940	940	1,300	30,500	62,782
Castle Dome.....	2		15,034	1	1	950	950	670,400			243
Copper Basin.....	1		40	1	1	21	21	8,000			95,777
Copper Creek.....	1	1	670,084	94	6	25,972	25,972	9,833,800	53,800	408,500	1,410,410
Funka.....	6										70
Granite Creek.....	1	1			2						8,435
Hassayampa.....	7	6	468	37	41	3,354	3,354	25,400	13,400	1,000	2,401
Martinez.....	2		46	60	60	52	52	2,400			2,852
Pack.....	2		2	2	2	1,066	1,066	174,000	26,300	35,000	59,679
Pine Grove.....	2		3,417	654	654	10,132	10,132	4,400			18,033
Squaw Peak.....	1		150			24	24	3,000			7,798,842
Tiger.....	1		216	486	486	869	869	4,000	79,000		31,411
Turkey Creek.....	1	1	3	2	2	14	14	589,538			1,649
Verde.....	6		525,263	8,620	8,620	589,538	589,538	4,000			100,889
Walker.....	6		400	649	649	2,468	2,468				13,795
Weaver.....	1	1	32	55	55	24	24				16,685
White Picacho 1.....	8		220	7	7	734	734	4,400	3,600		1,771
Yuma County:											41,812
Castle Dome.....	1	1	16,424	4		14,874	14,874		1,122,600		15,363
Cienega.....	4		1,401	151	151	45	45	62,800			
Ellsworth (Harqua Hala) 1.....	3		2,842	69	69	703	703	102,000	18,600		
Never Swept.....	1		85			398	398				
Plomosa.....	6		1,878	230	230	36,239	36,239	36,800	37,800		
Santa Maria (Planet, Bill Williams).....	1		1,072			76	76	113,400			
Total Arizona.....	228	17	35,900,641	111,920	242	112,162	4,393,949	90	4,394,039	716,606,000	33,414,000
										58,154,000	113,094,806

1 Ellsworth district lies in both Maricopa and Yuma Counties.

2 White Picacho district lies in both Maricopa and Yavapai Counties.

3 Old Hat district lies in both Pima and Pinal Counties.

COCHISE COUNTY

California district (Hilltop).—The Crosby mine near Portal was the only producer in the California district in 1944; a lessee operated the mine nearly all the year and shipped 1,011 tons of copper ore to a smelter.

Cochise district.—William A. Hooton operated the Mammoth mine 7 miles north of Dragoon in 1944 and shipped 1,543 tons of copper ore to smelters in Arizona and 2,160 tons of zinc-copper ore to the custom flotation mill of the Eagle-Picher Mining & Smelting Co. near Sahuarita; the rest of the district output was 648 tons of low-grade copper ore produced from the Centurion mine by the Captain Copper Co. The Coronado Copper & Zinc Co. developed its ore body at the Republic mine throughout the year and started erecting a 150-ton flotation mill.

Dos Cabezas and Tevis district.—All the output (373 tons) of the Dos Cabezas and Tevis district in 1944 was highly siliceous copper ore produced from the Tout group.

Golden Rule (Dragoon) district.—A lessee operated the Dragoon Zinc mine a short time in 1944 and shipped 256 tons of zinc ore to the Shattuck Denn custom flotation mill at Bisbee.

Hartford (Huachuca Mountains) district.—The State of Texas mine near Hereford was operated throughout 1944, and 191 tons of zinc-lead ore were shipped to a custom flotation mill at Bisbee; the rest (50 tons) of the district output was virtually all silver-lead ore produced from the Armistice property.

Swisshelm district (Elfrida).—Leasing operations at the Scribner mine from May 1944 to the end of the year produced 1,232 tons of silver-lead ore, which was shipped direct to the smelter at El Paso, Tex.

Tombstone district.—Mining operations in the Tombstone district have declined greatly during the past decade. In 1944 the output of ore dropped to 1,265 tons, and it was virtually all silver-lead ore shipped to a smelter from the Tombstone Extension mine.

Turquoise district (Courtland, Pearce, Gleeson).—In 1944 a total of 1,502 tons of smelting ore was produced from four mines in the Turquoise district—997 tons of copper ore from the Shannon group, 170 tons of silver-lead ore and 55 tons of copper ore from the Tom Scott mine, 199 tons of silver-copper ore from the Black Diamond mine, and 48 tons of lead ore and 33 tons of zinc ore from the Defiance property.

Warren district (Bisbee, Warren).—In 1944 the Warren district ranked first in the State in output of gold, silver, and zinc, second in lead, and fourth in copper; however, the output of gold, silver, and copper was much less than in 1943 and the production of lead and zinc much greater. The principal output was copper ore and zinc-lead ore from the Copper Queen branch of the Phelps Dodge Corporation. The company reported that 634,650 tons of copper ore were shipped direct to the smelters at Douglas and Clarkdale; these shipments included 3,998 tons of low-grade marginal ore mined for the account of Metals Reserve Company and sent to Clarkdale for treatment (shipments of this class of ore ceased in January) and 157,148 tons of siliceous flux ore produced from the "Southeast Extension" porphyry ore body for the Douglas smelter. In addition,

733 tons of copper precipitates were produced by the surface and underground precipitation plants, and 55,571 tons of zinc-lead ore were shipped to custom flotation mills near Bisbee and Sahuarita.

According to the company annual report for 1944, efforts to achieve maximum copper production in 1944 were seriously handicapped by a shortage of manpower, resulting in a marked decline in the output of copper, gold, and silver. The contract with Metals Reserve Company made in April 1943, for the shipments of copper ore from the "Cole Division" to the Clarkdale smelter, was modified to include higher-grade copper ore from the "Junction Division," but this contract was terminated in September 1944 by the Metals Reserve Company. A total of 31,817 feet of exploration and development headings was driven in 1944, as well as 5,318 feet of stope preparation and 28,054 feet of diamond drilling. In the face of operating difficulties that existed throughout the year it is considered that ore reserves were satisfactorily maintained. No new copper ore bodies of any extent were developed, but the zinc-lead ore exploration was encouraging.

Mining and milling operations at the Denn property of the Shattuck Denn Mining Corporation were continuous throughout the year; 66,688 tons of copper ore were shipped to the smelter at El Paso, Tex., and 3,440 tons of zinc-lead ore were treated by flotation. The company 150-ton flotation mill was utilized in 1944 principally for the treatment of custom ores, which totaled 50,246 tons. Nearly 82 percent of this ore was zinc-lead ore from the Copper Queen mine at Bisbee. The rest of the district output was 5,024 tons of copper ore shipped by a lessee working the Shattuck mine.

COCONINO COUNTY

Jacob Canyon and Warm Springs district.—The Mackin-Kennedy-Ryan group and the Petoskey group were leased in April 1944 by Atherley & Ryan. During the year 10,826 tons of carbonate copper ore were mined by a power shovel from surface pits at both groups and shipped to the smelter at Garfield, Utah. The remainder of the district output was a small lot (4 tons) of similar ore from the Brown Derby claim.

Kaibito Plateau district.—About 2,000 tons of highly siliceous copper ore were mined and shipped in 1944 from the Mardun property 57 miles north of Cameron. The Mardun Co. operated the property throughout the year and completed a 120-ton concentration plant

GILA COUNTY

Banner and Dripping Springs district.—A total of 26,227 tons of ore was produced in the Banner and Dripping Springs district in 1944; the principal output was 21,988 tons of copper ore shipped direct to a smelter from the Christmas mine by Sam Knight Mining Lease, Inc. The rest of the district output was mainly zinc-lead ore (4,109 tons) produced from the "79" mine by the 79 Lead-Copper Co. and treated in the Shattuck Denn custom mill at Bisbee. The Shattuck Denn Mining Corporation owns an approximate 60 percent interest in this mine; according to its annual report for 1944, the 79 Lead-Copper Co. was engaged in developing a new ore body that was encountered during the year. Shipments of zinc-lead ore from this new ore body and from an older ore body enabled the 79 Lead-Copper Co. to improve its financial condition materially.

Globe-Miami district.—The Globe-Miami district, with a production of 190,609,200 net pounds of copper in 1944 (201,026,600 net pounds in 1943), dropped from first place in 1943 to second in 1944 among the important copper-producing areas in Arizona; the Copper Mountain (Morenci) district in Greenlee County took first place. The Inspiration property, with a yield of 81,996,557 net pounds of copper (110,259,203 net pounds in 1943), was again the chief producer of copper in the district and ranked third in the State. The principal causes of a decreased production of copper were the shortage of labor throughout the year and the destruction by fire October 1 of the electrolytic tank house. The Inspiration Consolidated Copper Co. reported that 3,131,360 tons of ore from which the slimes had been removed were treated in the main leaching plant. This ore averaged 1.154 percent copper—0.589 percent copper as oxide and 0.565 percent as sulfide. Ferric sulfate leaching was used to treat 2,525,856 tons of ore during the first 9 months of the year, and during the last 3 months 605,504 tons of ore were treated with sulfuric acid solution. Extraction during the ferric sulfate leaching period was 98.38 percent of the oxide and 76.25 percent of the sulfide, or 88.26 percent of the total copper. The slimes (203,734 tons averaging 1.491 percent copper) removed from the ore were treated at the concentrator and the tailings from this operation were treated by sulfuric acid leaching, resulting in a combined recovery from concentration and leaching of slimes of 82.83 percent of the total copper. Leach-float operations on crude copper ore were carried on from the beginning of the year until August 3, when insufficient mine labor to produce the required tonnage of ore necessitated a suspension of such operations. During this period the leach-float plant treated 627,617 tons of ore averaging 1.174 percent copper—0.419 percent as oxide and 0.755 percent as sulfide; extraction was 85.83 percent of the total copper. From August 4 to September 20 the leach-float plant was used for testing a mixture of crude copper ore and slimes and on slimes alone; a total of 54,073 tons of material was treated during this testing period. During the last 3 months of the year 528,350 tons of leaching-plant tailings averaging 0.735 percent copper were treated at the concentrator; extraction was 77.46 percent of the total copper. In addition, 67 tons of leaching-plant cleanings and 109 tons of mine-water precipitates were shipped direct to the International smelter at Miami.

According to the annual report of the company for 1944, ore mined during the year totaled 4,016,784 dry tons assaying 1.175 percent copper—0.586 percent as oxide and 0.589 percent as sulfide. Total underground development aggregated 47,837 feet of drifts and raises and 4,821 cubic yards of miscellaneous development. After the electrolytic tank house was destroyed by fire October 1, as continuity of operations was urgently requested by representatives of the War Production Board the "Dual Process" (combined leaching and concentration) was substituted for the ferric sulfate leaching process. This change was completed by October 15, and operations are continuing satisfactorily although at a lower production rate than before the fire. Reconstruction of the tank house is proceeding as rapidly as possible, but resumption of the use of the ferric sulfate leaching process is not expected earlier than May 1945.

Mining and milling at the Miami property of the Miami Copper Co. were continuous throughout the year. The company 18,000-ton

concentrator and 3,000-ton leaching plant treated 4,717,138 tons (5,273,828 tons in 1943) of ore averaging 0.653 percent copper, and 3,839 tons of copper precipitates were produced from leaching of ore in place. In addition, 562 tons of molybdenum concentrates were recovered as a byproduct in treating copper ore. The Castle Dome Copper Co., Inc., a wholly owned subsidiary of Miami Copper Co., operated its open-pit mine near Miami continuously and treated 4,107,975 tons of ore averaging 0.708 percent copper; the capacity of the flotation plant, owned by Defense Plant Corporation and leased to the Castle Dome Copper Co., Inc., was increased from 10,000 to over 12,000 tons of ore a day during the last quarter of the year. According to the annual report of the Miami Copper Co. for 1944, operations at the open pit of the Castle Dome property more than fulfilled expectations and produced 49,987,529 net pounds of copper. Although the production of copper from the Miami mine fell considerably because of critical labor shortages, the combined production (106,136,695 net pounds of copper) from the Miami and Castle Dome mines was the highest for any year in the history of the company. Mine development in 1944 at the Miami property comprised 8,505 feet of drifts and 7,606 feet of raises. In addition, 25,724 feet of drifts and raises were driven in preparation for stoping. Although every effort was made to operate the mine at capacity, the shortage of labor became more critical during the year and reduced the production to an average of 82 percent of capacity; during the last few months of the year the manpower situation had deteriorated to such an extent that the mine was operated on two shifts instead of three. In addition to the serious curtailment of copper production, mine development has necessarily been so reduced that production may be curtailed even further in the near future. Moreover, the reserve of broken ore on hand in the mine at the end of the year was reduced to only 51 percent of that at the beginning. Operations at the Castle Dome property began in June 1943, so that 1944 represents the first full calendar year in operation. The shortage of labor at this open-pit mine is not as critical as that at the underground Miami mine. However, the open-pit mine is experiencing a very critical shortage of 14- by 24-inch rubber tires for the ore trucks, resulting in curtailment of stripping operations to favor current ore output; if continued, this may adversely affect future ore production.

The rest of the district output was largely copper ore (23,829 tons) shipped direct to a smelter by lessees from various claims and waste dumps of the Old Dominion property; copper ore shipped also from the Carlota mine (9,310 tons), Al & Hal claims (4,780 tons), Superior & Boston mine (3,842 tons), and Van Dyke mine (3,377 tons); and a total of 718 tons of lead ore shipped from the Albert Lea, Defiance, Gem, and Silver Bell properties.

Pioneer (Pinal Mountains) district.—Lessees operated the Bobaway and Mariana claims of the Bob Tail group in 1944 and shipped a total of 99 tons of silver-copper ore to a smelter.

Summit district.—The only output in the Summit district in 1944 was 349 tons of copper ore shipped to a smelter from the Gibson waste dump.

GRAHAM COUNTY

Aravaipa district.—Mining was carried on throughout the year at the Aravaipa group by the Athletic Mining Co.; a total of 4,017 tons of zinc-lead ore was shipped to custom milling plants near Bisbee and Sahuarita. The company plans to erect a milling plant at its property in the near future. The rest of the district output was 100 tons of lead ore produced from the Last Chance mine.

Lone Star district.—The Horseshoe mine 12 miles northeast of Safford was operated a short time in 1944, and 182 tons of copper ore were shipped to the smelter at Miami.

GREENLEE COUNTY

Ash Peak district.—Approximately 8,058 tons of fluxing ore averaging 0.03 ounce of gold and 6.43 ounces of silver to the ton and 84.40 percent silica were mined in 1944 from the Ash Peak mine by Ash Peak Lease and shipped to the International smelter at Miami. Similar ore (352 tons) was shipped from the Golden Eagle (Hardy) mine.

Copper Mountain district (Morenci).—The Copper Mountain district, with a production of 213,851,000 net pounds of copper in 1944 (168,694,400 net pounds in 1943), was the chief copper-producing area in Arizona. The Morenci mine of the Phelps Dodge Corporation was the outstanding producer of copper in the State. The company reported that 11,265,526 tons of copper ore were treated in the combined (Phelps Dodge and Defense Plant Corporation) 45,000-ton concentrator and that 46,571 tons of crude copper ore, 1,913 tons of copper precipitates, and 3,347 tons of old Clifton smelter cleanings were shipped direct to the Morenci smelter.

According to the annual report of the Phelps Dodge Corporation for 1944, the Defense Plant Corporation facilities at Morenci, Ariz., and El Paso, Tex., which are rented to the Phelps Dodge Corporation, began operating early in 1944. However, deficiency in manpower, resulting in curtailed ore production, prevented the utilization of these facilities to full capacity. At the Morenci open pit 11,328,097 tons of ore and 19,909,488 tons of waste material were extracted. Operations were conducted on 16 mining benches, ranging from the 4,600- to the 5,350-foot level; work on the 4,600-foot bench was begun during the last month of the year. All the construction work connected with the Defense Plant Corporation expansion program was essentially completed during 1944 except for some work at the open pit.

Nearly all the rest of the district output was crude, high-silica, copper oxide ore (4,110 tons) from the Keating mine, operated under lease by the Auto Specialties Manufacturing Co.

MARICOPA COUNTY

New River (Moore's) district.—Mining of sulfide copper ore was carried on at the Orizaba mine from January through May 1944, and 2,670 tons of ore were shipped to the smelter at Hayden; after May the mine was allowed to fill with water.

Osborn district.—In 1944 three properties—the Belmont-McNeil, U. S. (Furlough), and Moon Anchor—in the Osborn district were operated by the East Vulture Mining Co. The output comprised 3,427 tons of gold-silver-copper-lead ore and 320 tons of gold ore from

the Belmont-McNeil mine, 2,598 tons of low-grade gold ore from the U. S. waste-dump, and 240 tons of gold ore and 147 tons of lead ore from the Moon Anchor mine. Some of the ore was treated in a flotation plant, but most of it was shipped crude to various smelters.

Vulture district.—Nearly all the mines in the Vulture district have been idle since the Government gold-mine closing order of October 1942. Virtually all the 2,711 tons produced in 1944 was old tailings (gold) from the Vulture dump treated by cyanidation.

Wickenburg district.—Lessees continued in 1944 to work an old tailings dump at Wickenburg; 1,364 tons of low-grade gold material were shipped to various smelters in Arizona and 252 tons of similar material were treated by concentration.

MOHAVE COUNTY

Cedar Valley district.—Leasing operations at the Antler mine 20 miles southeast of Yucca by the Arizona Antler Mining Co. produced 1,568 tons of ore in 1944; most of it was zinc-copper ore shipped to a custom flotation mill at Midvale, Utah. Similar ore (766 tons) was produced from the Copper World mine by lessees and also shipped to Midvale for treatment.

Hacks Canyon district.—The Canyon Copper Co. continued in 1944 to operate the Hacks Canyon mine south of Fredonia and shipped 86 tons of carbonate copper ore to a smelter in Utah.

Orems (McCracken and Potts Mountain) district.—Lessees operated the Cleopatra mine from January through May 1944 and shipped 8,578 tons of high-silica gold-copper ore to the smelter at Clarkdale. The rest of the district output was virtually all crude copper ore (690 tons) produced from the Cactus Queen and Stein properties.

Wallapai district (Cerbat, Chloride, Mineral Park, Stockton Hill).—Zinc-lead ore produced from the Tennessee mine at Chloride by the Tennessee-Schuylkill Corporation continued to be the most important output in the Wallapai district; however, the property was closed October 6, 1944, largely because of an insufficient supply of labor. In December the president of the company was attempting to make arrangements to resume operations. During the year 20,300 tons of zinc-lead ore were treated in the company 150-ton flotation plant, which yielded 1,160 tons of lead concentrates and 1,900 tons of zinc concentrates. The Emerald Isle Copper Co. worked its property throughout the year, shipped 8,625 tons of crude carbonate copper ore to the smelter at Clarkdale, and completed erecting a 300-ton leaching plant. Leasing operations at the Summit group from February through December produced 3,131 tons of zinc-lead ore, which was shipped to a custom flotation mill at Midvale, Utah. The remainder of the district output was mainly zinc-lead ore (1,156 tons) from the Juno, Eureka, Hidden Treasure, Latest Out, and Minnesota-Connor properties.

PIMA COUNTY

Ajo district.—The Ajo district, with a production of approximately 92,500,000 net pounds of copper in 1944, ranked third in copper output among the copper-producing areas in the State, and it ranked second in gold and fourth in silver output; all the output came from the New Cornelia mine of the Phelps Dodge Corporation. The open pit at the property and the 25,000-ton concentrator were operated continuously throughout the year; the concentrator treated 6,454,071 tons of copper

ore in 1944 compared with 8,956,698 tons in 1943. According to the annual report of the Phelps Dodge Corporation for 1944, the New Cornelia open pit produced 6,454,878 tons of copper ore and 4,271,635 tons of waste. The longer haulage distances and higher lifts resulting from the development of the open pit probably will require new haulage equipment within the next few years. No major construction work was undertaken in 1944.

Amole district.—About 200 tons of gold-silver-lead ore from the waste-dump of the Old Yuma property were treated by concentration in 1944, and 224 tons of similar ore were shipped to a smelter. The rest of the district output was 42 tons of lead ore produced from the Twin Hill claim 22 miles west of Tucson.

Baboquivari district.—Lessees worked the Papago Chief mine from January through April 1944 and shipped 947 tons of high-silica gold-silver-copper ore to the smelter at Hayden. Operations were not profitable, and the lease terminated May 1.

Cerro Colorado district.—About 400 feet of drifting were done at the Mary "G" mine in 1944, resulting in shipments of 2 cars (73 tons) of silver-lead ore.

Helvetia (Rosemont) district.—Of the total ore (20,240 tons) produced in the Helvetia district in 1944, 19,589 tons were copper ore shipped to a smelter; nearly all the remainder was zinc-lead ore (347 tons) and zinc-copper ore (288 tons) shipped to a custom milling plant. The chief producers of copper ore were the Mohawk (10,086 tons), Copper World (5,387), Newman (1,347), Rosemont (1,336), and Bulldozer (1,077 tons); 347 tons of zinc-lead ore and 121 tons of copper ore were produced from the Daylight mine and 288 tons of zinc-copper ore from the Rosemont property.

Old Hat district (Oracle).—The Control Mines Co. operated the Geeseman mine and 100-ton mill continuously throughout the year; approximately 13,700 tons of copper ore were treated by flotation and 44 tons of similar ore shipped to a smelter. Copper ore (1,593 tons) was produced also from the Daily mine, which adjoins the Geeseman property, by the Daily Mines Co. and treated in the Control Mines Co. mill.

Pima (Sierritas, Papago, Twin Buttes) district.—The output of ore and the production of silver, copper, lead, and zinc in the Pima district were much greater in 1944 than in 1943, resulting from a full-year operation of the San Xavier property by the Eagle-Picher Mining & Smelting Co.; mining and milling operations at the property were begun in September 1943. During the summer months the company increased the capacity of its flotation mill from 150 to 350 tons of ore a day so as to treat custom ores. In 1944 the mill treated 52,136 tons of zinc-lead ore from the San Xavier mine and 18,337 tons of custom ores, which yielded 204 tons of copper concentrates, 6,213 tons of lead-copper concentrates, and 13,945 tons of zinc concentrates. The ore from the San Xavier mine averaged 3.52 ounces of silver to the ton, 0.75 percent copper, 6.22 percent lead, and 12.90 percent zinc. The rest of the district output was principally 1,426 tons of zinc ore from the San Xavier Extension mine and 1,111 tons of zinc-copper ore from the Contention mine treated in custom mills.

Roskrige and Waterman (Silver Hill) district.—A. R. Byrd, Jr., operated the Silver Hill mine continuously in 1944 and shipped 4,656 tons of crude copper-silver ore to various smelters in Arizona.

Silver Bell district.—The old Silver Bell mine 40 miles northwest of Tucson was worked by a lessee a short time in 1944, and 96 tons of silver-lead-copper ore were shipped to the smelter at El Paso.

PINAL COUNTY

Bunker Hill district (Copper Creek).—O. W. Blevins operated his Magma Chief group of claims near Sombrero Butte throughout the year and shipped 808 tons of copper ore to the smelter at Hayden; copper ore (34 tons) was shipped from the Mammoth Butte mine also.

Martinez Canyon district.—The California Steel Products Co. continued in 1944 to develop its Silver Bell-Martinez group 8 miles northeast of Price and shipped 423 tons of oxide lead ore to the smelter at El Paso.

Mineral Creek district (Ray).—Underground mining of copper ore at the Ray property of the Kennecott Copper Corporation was at a lower rate in 1944 than in 1943, resulting in a decrease in the output of ore from 2,351,900 to 1,893,683 tons. The crude ore, averaging 24.64 percent copper, was hauled by rail 26 miles to the company 500-ton flotation mill at Hayden, where it was reduced to 96,112 tons of copper concentrate. In addition, 4,850 tons of copper precipitates were shipped to various smelters. At the Ray property, the shortage of labor affected the output of ore even more seriously than at other Kennecott properties, as it was more difficult to secure employees for underground work than for open-pit operations. With the limited personnel available, development also had to be heavily curtailed and did not pace ore extraction.

Nearly all the remaining district output was crude oxide copper ore (5,136 tons) produced from an open pit at the Copper Butte property.

Old Hat district (Oracle).—Mining and milling were continuous at the Mammoth-Collins and New Year-Mohawk groups until September 4, when a fire destroyed the Mohawk shaft, gallows frame, hoist room, ore bins, and other structures. However, by the end of November the property was again producing as the shaft had been repaired and the surface structures completely rebuilt. During the year 42,409 tons of sulfide zinc-lead ore and 27,493 tons of oxide gold-silver-lead-molybdenum-vanadium ore were treated in the company 500-ton milling plant; the oxide ore was treated by gravity concentration, followed by flotation (flotation tailings were cyanided), and the sulfide ore was treated by straight flotation. The oxide lead concentrates (834 tons) were smelted in the company 20-ton lead furnace; and the sulfide lead concentrates (5,408 tons) and the sulfide zinc concentrates (5,896 tons), along with some high-grade gold-iron concentrates (48 tons), were shipped to smelters in Texas. Gold precipitates, as well as molybdenum and vanadium products and lead bullion, were shipped East. In addition, 1,507 tons of crude high-grade lead ore and 15 tons of mill cleanings were shipped to the smelter at El Paso. Mining and milling of oxide ore ceased temporarily July 31, as the company decided to confine its operations to the mining and milling of sulfide zinc-lead ore. The property was the largest producer of lead in Arizona in 1944 and ranked fifth in zinc.

A large deposit of copper-bearing material at a group of 21 claims known as the San Manuel, 1 mile south of Tiger, was examined in 1944 by the Federal Bureau of Mines and Federal Geological Survey. During the year the Magma Copper Co. secured an option to purchase the group, and according to the company annual report for 1944 the Bureau of Mines drilled 14 test holes and is continuing on 2 additional holes. This work indicated the possible presence of a large tonnage of copper-bearing rock which may average 0.7 to 1.0 percent copper.

The wide spacing of the churn-drill holes and the small outcrop or surface exposure of mineralization makes it impossible to determine the tonnage and grade of the deposit. The copper so far seen is mainly in the form of silicates and silicates and sulfides mixed; ore of this type presents a difficult metallurgical problem.

Pioneer district (Superior).—Mining operations at the Magma mine of the Magma Copper Co. were at a much lower rate in 1944 than in 1943, resulting in a decrease in output of ore from 414,183 to 305,262 tons. The company reported that 172,210 tons of copper ore and 88,849 tons of zinc-copper ore were treated in its 850-ton concentrator, and 44,203 tons of crude copper ore along with 60,450 tons of copper concentrates recovered from copper ore and 11,541 tons of copper concentrates recovered from zinc-copper ore were sent to the company 450-ton smelter at Superior. The zinc concentrates (8,456 tons) were shipped to Amarillo, Tex. The mill was operated 7 days a week until August 1 and 6 days a week thereafter.

According to the company printed annual report for 1944, the net metal produced from Magma ore and concentrates was 7,045 ounces of gold, 283,088 ounces of silver, 23,502,347 pounds of copper, and 7,333,007 pounds of zinc. The average net cost of producing copper after deduction of gold, silver, and zinc concentrate values was 12.48 cents a pound in 1944 compared with 10.28 cents in 1943. The decrease in production of gold, silver, copper, and zinc was the major cause of the greatly increased costs. The labor situation, bad in 1943, became progressively worse in 1944; during the latter half of the year the labor shifts actually worked were approximately 60 percent of those necessary for full production. The output of ore dropped from 34,872 tons in January to 15,203 tons in December. Copper ore was stoped from the 4,400 level to the 3,200 level. At the end of the year no known ore was left on the west side of the mine above the 3,400 level, and mining of copper ore was confined to the 4,000, 3,800, and 3,600 levels. Zinc-copper ore was stoped from the 2,250 level to above the 1,500 level on the east side of the mine. Development in 1944 comprised 2,927 feet of drifting, 2,610 feet of raising, 642 feet of crosscutting, and 114 feet of sinking.

The remainder of the district output was principally 1,370 tons of crude siliceous silver ore produced from the Reymert mine by Reymert Lease.

Summit district.—Haddy & Nelson leased the American Mines property west of Miami in 1944 and shipped 171 tons of copper ore to the International smelter at Miami.

SANTA CRUZ COUNTY

Harshaw district.—The American Smelting & Refining Co. operated the Trench and Flux groups 12 miles south of Patagonia continuously throughout the year and in October took over the January property. The total output from the three properties was 49,393 tons of zinc-lead-silver ore, which was treated in the company 200-ton flotation mill; however, the production of silver, lead, and zinc was much less than in 1943. The American Smelting & Refining Co. also operated the Hardshell mine throughout the year and shipped 1,295 tons of oxide silver-lead ore to the smelter at El Paso. The rest of the district output was nearly all siliceous silver ore (52 tons) produced from the Salvador claim.

Oro Blanco district (Ruby).—Mining of highly siliceous silver ore

was carried on at the Brick claim from January through August; 546 tons of ore of this class were shipped to various smelters in Arizona.

Palmetto district.—Pierce & Bird operated the old Three "R" mine 12 miles southwest of Patagonia throughout the year and shipped 4,162 tons of sulfide copper ore to the smelter at El Paso.

Patagonia (Duquesne) district.—Mining and milling zinc-lead-copper ore at the Duquesne property of the Callahan Zinc-Lead Co. were continuous until July 30, when operations ceased permanently; later the company moved its 140-ton mill to a property in Nevada. During the year 14,578 tons of ore from this mine were treated by flotation. In addition, the mill treated 2,326 tons of zinc-copper ore from the Pride of the West mine operated by the Humphrey Mining Co. The total output from the mill was 907 tons of copper concentrates, 234 tons of high-grade silver-lead concentrates, and 2,432 tons of zinc concentrates. Besides the zinc-copper ore produced from the Pride of the West mine and treated in the Duquesne mill, the mine also produced 1,284 tons of zinc lead ore which was treated in the Trench mill. The remainder of the district output comprised 909 tons of lead ore produced from the Mowry mine and 294 tons of copper ore from the Gladstone and Roy properties.

Tyndall district.—A total of 262 tons of ore was produced in the Tyndall district in 1944; most of it was silver-lead ore (141 tons) shipped to smelters from the Alto, Jefferson, and San Ramon properties, and copper ore (103 tons) from the Bland and Half Moon claims.

YAVAPAI COUNTY

Agua Fria district.—The total output in the Agua Fria district in 1944—11,917 tons of ore—was high-silica copper ore shipped direct to a smelter; 7,219 tons was produced from the Binghamton mine 6 miles east of Mayer, 3,906 tons from the Stoddard mine, 757 tons from the Burzog (Old Minor) property, and 35 tons from the Yaller Kid claim.

Big Bug district.—A total of 112,441 tons of ore and old tailings was produced in the Big Bug district in 1944, compared with 82,312 tons of ore and old tailings in 1943. The most important output was, as in 1943, zinc-lead ore (98,988 tons) from the Iron King mine at Humboldt treated by flotation. In addition, 170 tons of gold-silver ore were shipped direct to a smelter. The Shattuck Denn Mining Corporation operated the mine and its 325-ton (increased during 1944 from 240 tons of ore a day) flotation mill continuously throughout the year. The mill treated 103,231 tons of ore (including 4,243 tons of custom ores) in 1944, which yielded 4,430 tons of lead concentrates, 8,910 tons of zinc concentrates, and 5,290 tons of iron concentrates. About 8,000 tons of old copper tailings from the Humboldt tailing dump were treated by flotation. The rest of the district lode output was 4,000 tons of zinc-lead-copper ore from the Hackberry mine treated in the Iron King custom mill and 1,283 tons of copper ore from the Blue Bell mine shipped to the smelter at Clarkdale. The placer output was 202 ounces of gold and 21 ounces of silver recovered by sluicing at the Standard claim near Mayer.

Black Canyon district.—Lessees operated the French Lilly mine near Cleator in 1944 and hauled 123 tons of zinc-copper ore to the Iron King custom mill. The rest of the district output was mainly 121 tons of highly siliceous gold ore produced from an open pit at the Golden Turkey property and shipped direct to a smelter.

Black Hills district.—The Shylock mine near Dewey was operated a short time in 1944; 125 tons of siliceous silver-copper ore were shipped to the smelter at Clarkdale, and 4 tons of similar ore were produced from the Yaeger claim.

Black Rock district.—Virtually all the output of 101 tons of ore in the Black Rock district in 1944 was copper ore produced from the Bloo Nelly (Unida) mine, 10 miles north of Wickenburg.

Bullard (Pierce) district.—Mining operations at the Bullard mine near Aguila by Bullard Gold Mines, Inc., were continuous throughout the year; the company shipped 7,500 tons of siliceous gold-copper ore to smelters in Arizona.

Copper Basin district.—Fred D. Schemmer operated the Commercial mine near Skull Valley continuously in 1944 and shipped 15,527 tons of low-grade siliceous copper ore to the smelter at Clarkdale. The remainder of the district output was 111 tons of crude zinc ore produced from the Boston-Arizona mine and hauled to a custom flotation mill at Humboldt.

Eureka district.—Mining and milling of copper ore at the Bagdad property of the Bagdad Copper Corporation were at a much greater rate in 1944 than in 1943. The company reported that 668,887 tons of copper ore (375,715 tons in 1943) were treated in its 2,500-ton flotation plant and that 11,298 tons of concentrates averaging 43.70 percent copper were shipped to the smelter at El Paso. In addition, some molybdenum concentrates were sold to the Molybdenum Corporation of America. The rest of the district output was mainly 592 tons of zinc oxide ore, 446 tons of zinc-lead ore, and 216 tons of copper ore shipped to various reduction works from the Copper King mine and 802 tons of copper ore from the Eureka and Old Dick properties.

Hassayampa (Groom Creek, Hassayampa River, Senator, Prescott) district.—The principal output in the Hassayampa district in 1944 was 416 tons of copper ore from the Van Hook and Treadwell properties near Prescott and 34 tons of lead ore from the Bodie mine.

Martinez (Congress) district.—Mining operations in the old gold district of Martinez in 1944 were insignificant compared with earlier years; the only output in 1944 was 33 tons of gold ore from the Congress mine and 13 tons of copper ore from the Senate mine.

Pine Grove district (Crown King).—Lessees operated the Springfield mine from March through December and shipped 1,952 tons of siliceous copper ore to the smelter at Clarkdale. The remainder of the district output comprised 900 tons of zinc-lead-gold ore treated in a flotation mill and 565 tons of gold ore shipped direct to a smelter from the Gladiator-War Eagle group by the Gladiator Mining Co.

Tiger district.—Leasing operations at the Pilgrim claim near Crown King in 1944 resulted in the shipment of 5 cars (216 tons) of rich gold ore.

Verde district (Jerome).—Copper ore mined from the underground workings of the United Verde property of the Phelps Dodge Corporation continued in 1944 to be the most important output in the Verde district; however, production decreased from 879,170 tons in 1943 to 503,620 tons in 1944. Of the ore mined in 1944 from the property 150,506 tons was siliceous copper ore shipped to the corporation smelter at Clarkdale and 353,114 tons was similar ore treated in the corporation 2,100-ton concentrator. In addition, 365 tons of copper precipitates were shipped to the smelter.

According to the annual report of the corporation for 1944, the decline in tons of ore mined resulted from a shortage of labor and from

a depletion of ore reserves. By the end of the year all minable ore, with the exception of the shaft pillars, was exhausted above the 1,800 level. Development totaled 40,895 feet, comprising 4,968 feet of drifting, 1,027 feet of raising, 370 feet of calyx drill holes, and 34,530 feet of diamond drilling. Practically all of this work was for exploratory purposes in the deep levels of the mine; the results were disappointing, and no tonnage of economic importance was added to the ore reserves.

The rest of the district output comprised 11,452 tons of siliceous gold-silver ore from the Iron King-Equator group, shipped by lessees to the smelter at Clarkdale, and 10,191 tons of siliceous copper ore shipped to a smelter from the Dundee-Arizona, Florentia, and Verde properties.

Walker district.—The principal output in the Walker district in 1944 was 379 tons of high-grade gold-lead ore produced from the Emma and Oro Plata properties and shipped to a smelter.

Weaver district (Octave).—Lessees worked the Monica mine a short time in 1944 and shipped 28 tons of highly siliceous gold ore to the smelter at Hayden. The remainder of the district output was 4 tons of old mill cleanings (valued chiefly for gold) and 3 ounces of placer gold.

White Picacho district.—The output of the White Picacho district in Yavapai County in 1944 comprised 210 tons of gold-copper ore produced from the Jumbo group, 14 tons of silver-lead ore from the Independence mine, and 6 tons of gold ore from the Vanadium claim.

YUMA COUNTY

Castle Dome district.—Mining and milling of lead ore at the De Luce group by the Arizona Lead Co. were continuous throughout the year. The company treated 16,382 tons of oxide lead ore in its 150-ton mill, equipped with jigs and tables, and shipped 42 tons of high-grade oxide lead ore to the smelter at El Paso. The rest of the district output was 9 ounces of gold and 69 ounces of silver recovered from gravel at the Ocatilla placer.

Cienega district.—The principal output of the Cienega district in 1944 was 1,293 tons of highly siliceous gold-copper ore produced from the Empire-Arizona property, 12 miles east of Parker, by Strategic Metal Mines.

Ellsworth (Harqua Hala) district.—Low-grade gold-copper ore (2,839 tons) mined from the Yuma Copper mine near Vicksburg by the Liberator Mines Co. was virtually all the output in the Ellsworth district in 1944.

Never Sweat district.—Lessees worked the Addie property north of Bull in 1944 and shipped 85 tons of lead ore to the smelter at El Paso.

Plomosa district.—The Little Butte mine, 4 miles southwest of Bouse, was operated (under lease) throughout the year by the New World Mining Co., which shipped 768 tons of low-grade gold-copper ore and 126 tons of fairly rich gold ore to various smelters in Arizona. The remainder of the district output was largely 698 tons of siliceous silver ore and 165 tons of siliceous silver-lead ore produced from the R. & A. mine by various lessees.

Santa Maria (Planet, Bill Williams) district.—During the first 6 months of 1944 the Swansea Development Co. continued to operate (under lease) the Swansea mine and shipped 1,072 tons of copper ore to the smelter at Hayden. At the end of June the mine was shut down and the lease canceled.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA

(MINE REPORT)

By CHARLES WHITE MERRILL

SUMMARY OUTLINE

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SUMMARY

California gold production in 1944 fell below that in any year since 1848—the year James A. Marshall made his historic discovery in the gravels of the American River near Coloma. Silver production, though 28 percent higher than in 1943, otherwise was the lowest since 1933 in quantity and 1934 in value. However, copper production was the largest in both quantity and value since 1930; zinc was the largest in quantity since 1926 and in value since 1916; and lead, though 2 percent smaller in quantity than in 1943, was larger in value than in any year since 1918. The total value of the five metals (\$10,933,-495), though 19 percent higher than in 1943, was otherwise the lowest since 1848. Higher wages, enlistment of miners in the armed forces, migration of miners to war industries, rising prices of supplies and equipment and difficulties in obtaining them, increased taxes, and the fixed prices of gold and silver were factors accelerating the downward trend, which was already under way in 1942. In addition, throughout 1943 and 1944, War Production Board Limitation Order L-208 (promulgated October 8, 1942) prevented all larger gold operations except under special grant. California gold miners were issued grants as follows: During 1942, 18; during 1943, 27; and during 1944, 25; none was rescinded. Thus of the 119 grants issued to domestic gold miners, California producers received 70 and those in all other States 49.

Comparing 1944 with 1943, gold decreased 21 percent but silver increased 28 percent in both quantity and value; copper increased 45 percent in quantity and 51 percent in value; lead decreased 2 percent in quantity but increased 4 percent in value; and zinc increased 356 percent in quantity and 381 percent in value. The total value of the five metals was 19 percent more than in 1943; of the total value gold represented 38 percent, copper 31 percent, zinc 18 percent, lead 8 percent, and silver 5 percent.

The counties of the State, arranged by value of output of the 5 metals, were in very different order in 1943 and 1944 from preceding

years, because in these latter years it was base-metal output that raised counties to leadership, whereas in earlier years the counties at the top of the list were invariably big gold producers. Siskiyou County, second on the list in 1943 and eighth in 1942, was the leader in 1944 owing almost entirely to the copper output of the Dakin mine, Mammoth River district, operated by the Gray Eagle Copper Co. Elko County, second on the list in 1944, was first in 1943 but seventh in 1942; lead represented over half of the total value of its metal output, and the value of each of the other 4 metals was also substantial. Mariposa County, third on the list in 1944, owed its position largely to the zinc production of the Blue Moon mine, Hunter Valley district, operated by Red Cloud Mines, Inc. Calaveras County was fourth on the list in 1944, with operations along the Mother Lode and in the

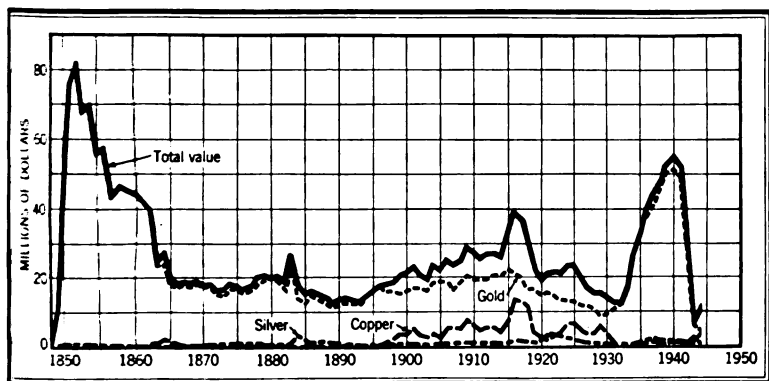


FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, and zinc in California, 1848-1944. The value of lead and zinc has exceeded \$1,000,000 in only a few years.

East Belt largely suspended but copper and zinc-copper mines west of the Mother Lode reporting large outputs. Yuba County, which had been in third place in 1942 and 1943 largely as the result of gold output of its connected-bucket gold dredges, dropped to fifth place in 1944 despite the War Production Board grant permitting the working of 2 of the large dredges in the Yuba Consolidated Gold Fields' fleet of 6 boats. Other counties of the leading 10, listed in order of total value of output, were: Shasta County (largely from copper-zinc ore), Sacramento County (almost entirely from connected-bucket dredging), Butte County (largely from connected-bucket dredging and some zinc ore), Nevada County (largely from gold ore), and Tuolumne County (largely from gold ore of the Eagle Shawmut mine). Of the 30 counties producing, these 10 furnished 92 percent of the total value of the five metals produced in the State during the year.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ³	Zinc ³
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940.....	\$35.00	\$0.7114	\$0.113	\$0.050	\$0.093
1941.....	35.00	0.7114	.118	.057	.075
1942.....	35.00	0.7114	.121	.067	.093
1943.....	35.00	0.7114	.130	.075	.108
1944.....	35.00	0.7114	.135	.080	.114

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price includes bonus payments by Metals Reserve Company for overquota production.

⁴ \$0.71111111.

Mine production of gold, silver, copper, lead, and zinc in California, 1940-44, and total, 1848-1944, in terms of recovered metals

Year	Mines producing ¹		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1940.....	1,030	836	4,669,433	1,455,671	\$50,948,485	2,359,776	\$1,678,063
1941.....	835	724	4,280,185	1,408,793	49,307,755	2,154,188	1,531,867
1942.....	434	428	2,503,198	847,997	29,679,895	1,450,440	1,031,424
1943.....	139	82	739,956	148,328	5,191,480	609,075	433,120
1944.....	109	66	925,953	117,373	4,108,055	778,936	553,910
1848-1944.....			(²)	101,376,457	2,250,279,647	105,870,639	85,354,357

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1940.....	12,876,000	\$1,454,988	3,544,000	\$177,200	158,000	\$9,954	\$54,268,690
1941.....	7,886,000	930,548	6,928,000	394,896	880,000	66,000	52,231,066
1942.....	2,116,000	256,036	10,302,000	690,234	1,226,000	114,018	31,771,607
1943.....	17,524,000	2,278,120	11,640,000	873,000	3,712,000	400,896	9,176,616
1944.....	25,442,000	3,434,670	11,364,000	909,120	16,910,000	1,927,740	10,933,495
1848-1944.....	³ 615,111	198,172,394	³ 142,505	17,237,275	³ 63,407	11,898,118	2,562,941,791

¹ Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

² Figures not available.

³ Short tons.

Gold produced at placer mines in California, 1940-44, by classes of mines and by methods of recovery, and total, 1848-1944 ¹

Class and method	Mines producing ²	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered		
				Fine ounces	Value	Average per cubic yard
Surface placers:						
Gravel mechanically handled:						
Connected-bucket dredges:						
1940.....	32	46	132,461,000	414,966	\$14,523,810	\$0.110
1941.....	37	47	135,757,000	418,282	14,639,870	.108
1942.....	30	44	106,543,000	310,537	10,882,795	.102
1943.....	8	10	17,880,000	66,999	2,344,965	.131
1944.....	5	7	21,524,000	64,925	2,272,375	.106
Dragline dredges:						
1940.....	198	106	42,747,000	205,181	7,181,335	.168
1941.....	234	112	45,579,000	225,019	7,875,665	.173
1942.....	122	79	24,526,000	117,906	4,129,710	.168
1943.....	3	3	3,180,000	14,196	496,860	.156
1944.....	2	2	1,213,000	6,241	218,435	.180

See footnotes at end of table.

Gold produced at placer mines in California, 1940-44, by classes of mines and by methods of recovery, and total, 1848-1944 ¹—Continued

Class and method	Mines producing ²	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered		
				Fine ounces	Value	Average per cubic yard
Surface placers—Continued.						
Gravel mechanically handled—Continued.						
Becker-Hopkins dredges:						
1940 ³	2	2	35,000	148	\$5,180	\$0.148
1941.....	3	2	52,000	244	8,540	.164
1942.....	1	—	5,000	23	805	.161
1943-44.....	—	—	—	—	—	—
Suction dredges: ⁴						
1940 ⁵	4	4	64,000	584	20,440	.319
1941.....	17	17	357,000	1,763	61,705	.173
1942.....	18	15	278,000	1,419	49,665	.179
1943-44.....	—	—	—	—	—	—
Nonfloating washing plants: ⁶						
1940.....	131	105	5,908,000	28,232	988,120	.167
1941.....	85	76	5,656,000	28,703	1,004,605	.178
1942.....	46	40	1,637,000	10,044	351,540	.215
1943.....	16	15	547,000	2,997	104,895	.192
1944.....	14	14	223,000	1,210	42,350	.190
Gravel hydraulically handled:						
Hydraulic:						
1940.....	92	—	2,401,000	12,059	422,065	.176
1941.....	79	—	2,886,000	10,145	355,075	.123
1942.....	45	—	1,980,000	6,106	213,710	.108
1943.....	12	—	366,000	1,723	60,305	.165
1944.....	13	—	212,000	838	29,330	.138
Small-scale hand methods:						
Wet:						
1940.....	278	—	1,710,200	38,526	1,348,410	.788
1941.....	182	—	1,599,700	29,040	1,016,400	.635
1942.....	119	—	1,152,900	16,079	562,765	.488
1943.....	29	—	118,460	2,536	88,760	.749
1944.....	25	—	96,000	1,408	49,280	.513
Dry:						
1940.....	17	—	10,800	211	7,385	.684
1941.....	13	—	7,300	220	7,700	1.055
1942.....	7	—	1,100	73	2,555	2.323
1943.....	1	—	40	4	140	3.500
1944.....	(7)	—	200	3	105	.525
Underground placers:						
Drift:						
1940.....	96	—	88,000	5,045	176,575	2.007
1941.....	74	—	90,000	4,597	160,895	1.788
1942.....	45	—	22,000	2,339	81,865	3.721
1943.....	13	—	4,500	970	33,950	7.544
1944.....	7	—	3,800	424	14,840	3.905
Grand total placer:						
1940.....	836	—	185,425,000	704,952	24,673,320	.133
1941.....	724	—	191,984,000	718,013	25,130,455	.131
1942.....	428	—	136,145,000	464,926	16,272,410	.120
1943.....	82	—	22,096,000	89,425	3,129,875	.142
1944.....	66	—	23,272,000	75,049	2,626,715	.113
1848-1944 ¹	—	—	(*)	65,169,542	1,416,671,616	(*)

¹ For historic data by years see Minerals Yearbook, Review of 1940, p. 219.

² Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

³ First year for which this method was reported used in California.

⁴ Includes all placer operations using suction pump for delivering gravel to floating washing plant, except those producing less than 100 ounces of gold which are included under "Small-scale hand methods."

⁵ Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."

⁶ Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dry boxes, pans, rockers, dry washers, etc.

⁷ From property not classed as a "mine."

⁸ A mine using more than 1 method of recovery is counted but once in arriving at total for all methods.

⁹ Complete data not available.

*Gold.*¹—An uninterrupted rise beginning in 1929 culminated in the production of \$50,948,485 in gold in 1940, the largest value since 1856. In 1941, however, a reaction set in that gained headway in 1942. By January 1943 monthly production had sunk to 16,425 fine ounces, and since that time it has fluctuated between that figure and a low of 8,547 ounces established in February 1943. The monthly fluctuations were narrower during 1944; the monthly average for the year was 9,781 ounces compared with a monthly average of 12,361 ounces for 1943. Compared with 1942, the decrease of 699,669 ounces (\$24,488,415) recorded in 1943 was greater in both quantity and value than that between any other 2 years in the State's history, not excluding 1852-53, 1854-55, and 1856-57, when flush placer output was failing; 1883-84, when the Sawyer Decision drastically reduced hydraulicking; and 1917-18, when World War I caused many operations to suspend or curtail output. The decrease of 30,955 ounces valued at \$1,083,425 in 1944 from 1943 seems small when the decrease of the 2 preceding years is considered.

Mine production of gold in California, 1937-44, by months, in fine ounces, in terms of recovered metal

Month	1937	1938	1939	1940	1941	1942	1943	1944
January.....	83,964	96,469	106,362	128,127	129,894	101,698	16,425	10,216
February.....	82,357	94,368	112,497	112,536	123,735	91,945	8,547	8,772
March.....	89,116	100,029	116,171	120,596	120,462	95,344	14,440	10,111
April.....	102,217	107,512	113,587	119,063	129,664	92,652	12,461	9,673
May.....	104,850	106,103	124,682	127,467	121,231	87,037	13,424	10,013
June.....	86,449	103,027	122,306	130,111	118,462	84,016	15,552	9,972
July.....	113,251	112,240	122,672	91,678	120,089	70,002	12,910	9,774
August.....	95,756	111,680	113,185	110,666	118,379	64,615	12,759	9,177
September.....	96,777	116,532	122,506	105,443	108,430	56,108	10,501	8,917
October.....	107,971	113,174	125,713	124,085	111,658	56,502	11,411	10,892
November.....	104,580	120,339	128,273	136,181	101,591	27,919	10,074	9,638
December.....	107,290	129,656	127,310	149,718	105,198	20,159	9,824	10,218
Total.....	1,174,578	1,311,129	1,435,264	1,455,671	1,408,793	847,997	148,328	117,373

A study of the monthly production figures since January 1937 brings out some points that are obscure in the annual figures. The uninterrupted upward trend shown in the annual figures beginning in 1929 and culminating in 1940 is paralleled in the available monthly data. It will be noted, however, that a serious recession was experienced in July 1940 from which industry did not fully recover until November. This was caused by a labor strike at the Selby smelter and refinery of the American Smelting & Refining Co., which resulted in the postponement of many shipments of ore, concentrates, and bullion; the strike was called July 1, and work was resumed November 9. The peak reached in December 1940 may be attributed, at least in part, to the movement of material accumulated during the strike. Beginning with January 1941, however, the trend is unmistakably downward, and the rate of decline accelerates as the months pass. The downward plunge is arrested in October 1942 probably because many operations, closed by War Production Board Order L-208, made final clean-ups, which were shipped before the end of the month. At any rate, the decline in November and December 1942 put the curve back on the precipitous trend line shown during the few months pre-

¹ Merrill, Charles White, War and Gold: Eng. and Min. Jour., vol. 146, No. 5, May 1945, pp. 80-89.

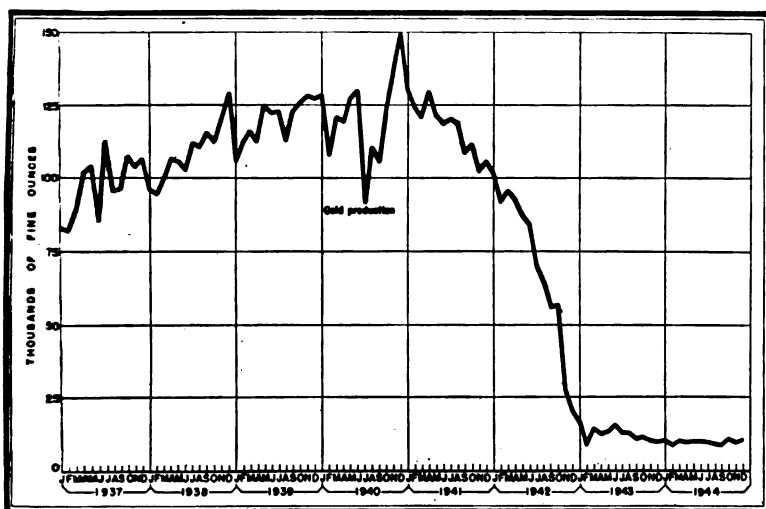


FIGURE 2.—Mine production of gold in California, 1937-44, by months, in terms of recovered gold.

Twenty-five leading gold-producing mines in California in 1944, in order of output

Rank	Mine	District	County	Rank in 1933	Operator	Source of gold
1	Yuba Unit.....	Yuba River.....	Yuba.....	1	Yuba Consolidated Gold Fields.	Dredge.
2	Natomas Co.....	Folsom.....	Sacramento.....	2	Natomas Co.....	Do.
3	Empire Star mines.	Grass Valley-Nevada City.	Nevada.....	6	Empire Star Mines Co., Ltd., and New Verde Mines Corp.	Gold ore.
4	Idaho Maryland-Brunswick.	do.....	do.....	(1)	Idaho Maryland Mines Corp.	Do.
5	Feather River channel.	Oroville.....	Butte.....	4	Golden Feather Dredging Co.	Dragline.
6	Eagle Shawmut...	Mother Lode.....	Tuolumne...	5	Miller & Clemson.....	Gold ore.
7	Tuolumne gold dredge.	La Grange.....	Stanislaus...	7	Tuolumne Gold Dredging Corp.	Dredge.
8	Oroville dredge....	Oroville.....	Butte.....	11	Oroville Gold Dredging Co.	Do.
9	Dakin (Gray Eagle).	Klamath River...	Siskiyou....	14	Gray Eagle Copper Co..	Copper ore.
10	Mount Gaines.....	Hunter Valley...	Mariposa....	15	Mount Gaines Mining Co.	Gold ore.
11	Original Sixteen to One.	Alleghany.....	Sierra.....	9	Original Sixteen to One Mine, Inc.	Do.
12	Blue Moon.....	Hunter Valley...	Mariposa....	(1)	Red Cloud Mines, Inc..	Zinc ore.
13	Columbia No. 2...	Resting Springs.	Inyo.....	10	Shoshone Mines, Inc..	Lead ore.
14	Tropico.....	Mojave.....	Kern.....	56	Burton Bros., Inc.....	Gold ore.
15	Qual Hill.....	West Belt.....	Calaveras...	18	G. Ivan Smith.....	Zinc ore.
16	Penn.....	Campo Seco.....	do.....	(1)	Eagle Shawmut Mine (Penn Division).	Do.
17	Big Bend.....	Yankee Hill.....	Butte.....	39	Hoeffling Bros.....	Do.
18	Lower Comanche dredge.	Camanche.....	San Joaquin.	21	Gold Hill Dredging Co..	Dredge.
19	Central Eureka....	Mother Lode.....	Amador.....	(1)	Central Eureka Mining Co.	Gold ore.
20	Kutras tract.....	Redding.....	Shasta.....	19	Columbia Construction Co., Inc.	Nonfloat.
21	Hornet.....	Flat Creek.....	do.....	30	The Mountain Copper Co., Ltd.	Copper ore.
22	St. Jude.....	French Gulch.....	do.....	(1)	St. Jude Mining Co.....	Gold ore.
23	Roosevelt.....	Buckeye.....	San Bernardino.	(1)	Roosevelt Mines, Inc..	Do.
24	Pine Tree and Josephine.	Mother Lode.....	Mariposa....	13	Pacific Mining Co.....	Do.
25	Schroeder group...	East Belt.....	do.....	38	Schroeder, Odgers, & Schroeder.	Do.

¹ Not operated in 1943.

ceding October. By January production had reached a level that permitted little further recession, and this low level has ruled throughout 1943 and 1944 with only a slight additional decline.

The 25 leading gold-producing mines in California in 1944, listed in the foregoing table, yielded 90 percent of the total gold output of the State; the leading 5 mines produced 62 percent and the leading 10 mines 79 percent. Many changes have taken place in the list since 1943; and only 8 of the mines listed in 1942 are on the 1944 list.

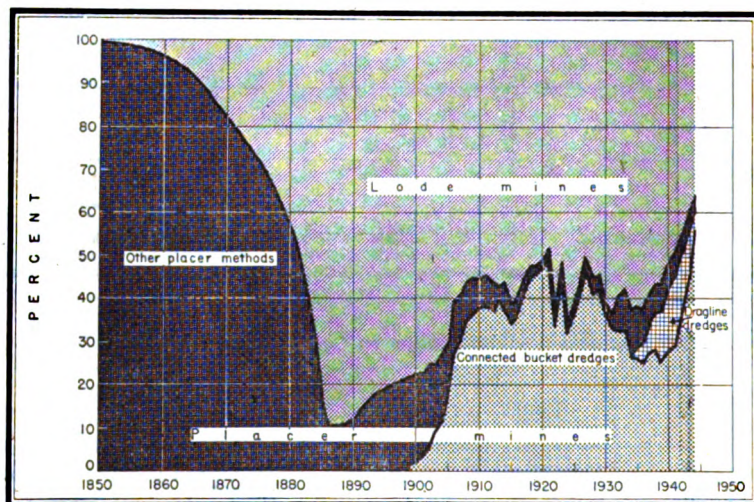


FIGURE 3.—Percentage of total California gold produced at lode and placer mines and by various methods of placer mining, 1850-1944.

Silver.—Most of the silver output in California in 1944 was more localized than that of the gold; the 10 leading silver-producing mines listed in the following table yielded 82 percent of the State total recoverable silver in that year, and the 4 leading mines yielded 62 percent. All 10 leading mines derived their silver from argentiferous base-metal ores.

Ten leading silver-producing mines in California in 1944, in order of output

Rank	Mine	District	County	Rank in 1943	Operator	Source of silver
1	Darwin group	Coso	Inyo	2	Darwin Mines (Arthur J. Theis, trustee).	Lead ore.
2	Blue Moon	Hunter Valley	Mariposa	(¹)	Red Cloud Mines, Inc.	Zinc ore.
3	Columbia No. 2	Resting Springs	Inyo	1	Shoshone Mines, Inc.	Lead ore.
4	Hornet	Flat Creek	Shasta	5	The Mountain Copper Co., Ltd.	Copper ore.
5		Coso	Inyo	32	Louis Warnken, Jr.	Lead ore.
6	Pine Creek	Bishop Creek	do	4	United States Vanadium Corp.	Tungsten-molybdenum ore.
7	Penn	Campo Seco	Calaveras	(¹)	Eagle Shawmut Mine (Penn Division).	Zinc ore.
8	Quall Hill	West Belt	do	7	G. Ivan Smith	Do.
9	Silverado	Santa Rosa	Orange	(¹)	Blue Light Silver Mines Co.	Do.
10	Last Chance	Coso	Inyo	6	L. D. Foreman & Co.	Lead ore.

¹ Not operated in 1943.

Copper.—Copper production in California in 1944 was the largest in both quantity and value since 1930. Most of the copper came from mines brought into production since 1942. The following 11 companies, listed in order of copper output and each producing more than 100,000 pounds, supplied 98 percent of the State total and the first three 87 percent: Gray Eagle Copper Co. (Dakin mine, Klamath River district, Siskiyou County); Keystone Copper Corp. (Keystone mine, Copperopolis district, Calaveras County); The Mountain Copper Co., Ltd. (Hornet mine, Flat Creek district, Shasta County); Pacific Mining Co. (Union mine (old tailings), Copperopolis district, Calaveras County); Hoefling Bros. (Big Bend mine, Yankee Hill district, Butte County); Winston Copper Co. (Newton mine, Ione district, Amador County); United States Vanadium Corp. (Pine Creek mine, Bishop Creek district, Inyo County); Eagle Shawmut Mine (Penn mine, Campo Seco district, Calaveras County); L. D. Foreman & Co. (Copper World smelter site (old slag dump), Clark Mountain district, San Bernardino County); G. Ivan Smith (Quail Hill mine, West Belt district, Calaveras County); and Red Cloud Mines, Inc. (Blue Moon mine, Hunter Valley district, Mariposa County).

Lead.—Lead production in California in 1944 was slightly smaller than in 1943, but its value exceeded that in any year since 1918. The two leading producers contributed over 67 percent of the State total in 1944. The following nine companies, listed in order of lead output and each producing over 100,000 pounds, furnished 94 percent of the State total: Darwin Mines (Essex and Independence mines, Coso district, Inyo County); Shoshone Mines, Inc. (Columbia No. 2 mine, Resting Springs district, Inyo County); Damon & Damon (Gold Bottom and Ophir mines, Slate Range district, Inyo County); L. D. Foreman & Co. (Last Chance (slag dump), Coso district, Inyo County); Louis Warnken, Jr. (old tailings, Coso district, Inyo County); Clayton T. McNeil & C. Erb Wuensch (old flue dust, Flat Creek district, Shasta County); Imperial Metals, Inc. (Cerro Gordo mine, Cerro Gordo district, Inyo County); Dunton-Ray & Greenwood (Mohawk mine, Clark Mountain district, San Bernardino County); and Red Cloud Mines, Inc. (Blue Moon mine, Hunter Valley district, Mariposa County).

Zinc.—Zinc production in California in 1944 was the largest in quantity since 1926 and in value since 1916. Most of the output came from mines brought into production since 1942. The following 12 companies, listed in order of zinc output and each producing over 100,000 pounds, contributed 99 percent of the State total: Red Cloud Mines, Inc. (Blue Moon mine, Hunter Valley district, Mariposa County); Hoefling Bros. (Big Bend mine, Yankee Hill district, Butte County); The Mountain Copper Co., Ltd. (Hornet mine, Flat Creek district, Shasta County); Eagle Shawmut Mine (Penn mine, Campo Seco district, Calaveras County); Darwin Mines (Essex and Independence mines, Coso district, Inyo County); Clayton T. McNeil & C. Erb Wuensch (old flue dust, Flat Creek district, Shasta County); G. Ivan Smith (Quail Hill mine, West Belt district, Calaveras County);

E. A. Vogt (Collier mine, West Belt district, Calaveras County); Damon & Damon (Gold Bottom and Ophir mines, Slate Range district, Inyo County); Dunton-Ray & Greenwood (Mohawk mine, Clark Mountain district, San Bernardino County); Shoshone Mines, Inc. (Columbia No. 2 mine, Resting Springs district, Inyo County); and Southwest Lead & Zinc Co. (Honolulu-Big Horn mine, South Park district, Inyo County).

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in California in 1944, by counties, in terms of recovered metals

County	Mines producing ¹		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine.....	1	—	15	\$525	—	—	15	\$525
Amador.....	5	(2)	691	24,185	43	\$1,505	734	25,690
Butte.....	2	8	569	19,915	10,066	352,310	10,635	372,225
Calaveras.....	9	3	1,844	64,540	89	3,115	1,933	67,655
Del Norte.....	—	1	—	—	3	105	3	105
Eldorado.....	3	1	58	2,030	24	840	82	2,870
Fresno.....	—	1	—	—	155	5,425	155	5,425
Humboldt.....	—	3	—	—	23	805	23	805
Inyo.....	16	—	2,571	89,985	—	—	2,571	89,985
Kern.....	9	4	1,226	42,910	65	2,275	1,291	45,185
Los Angeles.....	1	2	2	70	83	2,905	85	2,975
Madera.....	3	—	20	700	—	—	20	700
Mariposa.....	12	1	5,473	191,555	16	560	5,489	192,115
Merced.....	—	1	—	—	5	175	5	175
Mono.....	—	1	—	—	9	315	9	315
Nevada.....	3	1	15,949	558,215	80	2,800	16,029	561,015
Orange.....	1	—	51	1,785	—	—	51	1,785
Placer.....	1	5	43	1,505	364	12,740	407	14,245
Plumas.....	2	2	31	1,085	90	3,150	121	4,235
Sacramento.....	—	3	—	—	23,789	832,615	23,789	832,615
San Bernardino.....	18	1	790	27,650	129	4,515	919	32,165
San Diego.....	1	—	2	70	—	—	2	70
San Joaquin and Sierra ¹	4	4	2,776	97,160	5,486	192,010	8,262	289,170
Shasta.....	6	1	1,195	41,825	601	21,035	1,796	62,860
Siskiyou.....	5	7	3,282	114,870	400	14,000	3,682	128,870
Stanislaus.....	—	2	—	—	5,066	177,310	5,066	177,310
Trinity.....	2	8	18	630	532	18,620	550	19,250
Tuolumne.....	5	2	5,718	200,130	78	2,730	5,796	202,860
Yuba.....	—	4	—	—	27,853	974,855	27,853	974,855
Total, 1943.....	109	66	42,324	1,481,340	75,049	2,626,715	117,373	4,108,055
	139	82	58,903	2,061,605	89,425	3,129,875	148,328	5,191,480

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1944, by counties, in terms of recovered metals—Continued

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	671	\$477	—	—	671	\$477
Alameda	2,136	1,519	7	\$5	2,143	1,524
Butte	10,897	7,749	938	667	11,835	8,416
Calaveras	58,074	41,297	7	5	58,081	41,302
Col. Norte	—	—	—	—	—	—
El Dorado	803	571	4	3	807	574
Fresno	—	—	18	13	18	13
Humboldt	—	—	4	3	4	3
Inyo	411,003	292,269	—	—	411,003	292,269
Kern	1,046	744	14	10	1,060	754
Los Angeles	3	2	14	10	17	12
Madera	180	128	—	—	180	128
Mariposa	115,605	82,208	3	2	115,608	82,210
Merced	—	—	—	—	—	—
Mono	—	—	3	2	3	2
Nevada	12,739	9,059	13	9	12,752	9,068
Orange	16,318	11,604	—	—	16,318	11,604
Paver	360	256	41	29	401	285
Pumas	11	8	13	9	24	17
Sacramento	—	—	1,118	795	1,118	795
San Bernardino	27,221	19,357	28	20	27,249	19,377
San Diego	2	1	—	—	2	1
San Joaquin and Sierra ¹	523	372	551	392	1,074	764
Shasta	99,696	70,895	69	49	99,765	70,944
Siskiyou	14,272	10,149	76	54	14,348	10,203
St. Louis	—	—	180	128	180	128
Trenton	7	5	49	35	56	40
Tuolumne	2,838	2,018	14	10	2,852	2,028
Yuba	—	—	1,367	972	1,367	972
Total, 1943	774,405	550,688	4,531	3,222	778,936	553,910
	603,083	428,859	5,992	4,261	609,075	433,120

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Alpine	—	—	—	—	—	—	\$1,002
Alameda	474,000	\$63,990	2,000	\$160	—	—	91,364
Butte	486,000	65,610	54,000	4,320	2,888,000	\$329,232	779,803
Calaveras	4,902,000	661,770	178,000	14,240	2,172,000	247,608	1,032,575
Col. Norte	—	—	—	—	—	—	105
El Dorado	52,000	7,020	—	—	—	—	10,464
Fresno	—	—	—	—	—	—	5,438
Humboldt	—	—	—	—	—	—	808
Inyo	570,000	76,950	10,042,000	803,360	1,752,000	199,728	1,462,292
Kern	—	—	8,000	640	8,000	912	47,491
Los Angeles	—	—	—	—	—	—	2,987
Madera	74,000	9,990	—	—	—	—	10,818
Mariposa	112,000	15,120	238,000	19,040	6,692,000	762,888	1,071,373
Merced	—	—	—	—	—	—	175
Mono	—	—	—	—	—	—	317
Nevada	—	—	—	—	—	—	570,083
Orange	2,000	270	34,000	2,720	98,000	11,172	27,551
Paver	—	—	—	—	—	—	14,530
Pumas	—	—	—	—	—	—	4,252
Sacramento	—	—	—	—	—	—	833,410
San Bernardino	390,000	52,650	308,000	24,640	236,000	26,904	155,736
San Diego	—	—	—	—	—	—	71
San Joaquin and Sierra ¹	—	—	—	—	—	—	289,934
Shasta	2,584,000	348,840	500,000	40,000	3,064,000	349,296	871,940
Siskiyou	15,782,000	2,130,570	—	—	—	—	2,269,643
St. Louis	—	—	—	—	—	—	177,438
Trenton	—	—	—	—	—	—	19,290
Tuolumne	14,000	1,890	—	—	—	—	206,778
Yuba	—	—	—	—	—	—	975,827
Total, 1943	25,442,000	3,434,670	11,364,000	909,120	16,910,000	1,927,740	10,933,495
	17,524,000	2,278,120	11,640,000	873,000	3,712,000	400,896	9,176,616

¹ Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

² Output from property not classed as a "mine."

³ Combined to avoid disclosure of individual output.

MINING INDUSTRY

The tonnage of material from lode mines in California treated in 1944 increased 25 percent compared with 1943, and the yardage at placer mines increased 5 percent; the output of lode gold declined 28 percent and that of placer gold 16 percent. The increase in base-metal ore production more than counterbalanced the decrease in gold-ore output. The average recoverable gold content of gravels decreased 20 percent and was the lowest since 1932. Of the State total gold output in 1944, 36 percent came from lode mines and 64 percent from placers; this represents the highest placer: lode ratio since 1900, when separate annual data were first compiled, and is almost certainly the highest since large-scale hydraulicking was terminated by the Sawyer Decision of 1884.

Dredges of the connected-bucket type washed 92 percent of the total gravel mined in the State in 1944 and recovered 87 percent of the total placer gold; the value of gold produced by connected-bucket dredges was the smallest since 1904, and its quantity was the smallest since 1902. Dragline dredges washed 5 percent of the total gravel mined and recovered 8 percent of the placer gold, the lowest point reached by dragline dredging in either yardage washed or gold recovered since 1934—second year in which the method was used in California.

All other placer-mining methods, except small-scale hand methods (dry), showed decreases in both quantity of gravel washed and gold recovered. No Becker-Hopkins or suction dredges have been reported in production since 1942. Nonfloating washing plants to which gravel was delivered by mechanical means (dragline excavators, power shovels, slackline excavators, trucks, and bulldozers) treated much less gravel and recovered much less gold than in 1943. Many of the operators of such plants found that their equipment could be employed more profitably on war contracts; competition for labor skilled in operating earth-moving machines was very keen.

Hydraulic mining at established mines found itself singularly free from shortages of materials and power, but labor conditions caused marked reductions in operations. Very few hydraulic mines opened for the 1944-45 season. Gold production from small-scale hand methods was sharply curtailed. In normal times a large number of such operations are carried on independently by marginal workers, but the increasing labor shortage in California in 1944 caused many small-scale hand miners to abandon the streams and dry diggings for employment at wages. Drift mining, once very productive in California, also declined owing to war conditions.

Consumption of quicksilver at California placer mines totaled 1,375 pounds in 1944 compared with 2,026 pounds in 1943. The following quantities of gold were recovered to the pound of quicksilver used in 1944 (1943 figures in parentheses): Connected-bucket dredging, 63 ounces (40); dragline dredging, 46 ounces (49); nonfloating washing plants with mechanical gravel handling, 45 ounces (49); hydraulicking, 40 ounces (11); and small-scale hand operations, 9 ounces (23).

ORE CLASSIFICATION

Of the 925,953 tons of ore (including 234,109 tons of old tailings) sold or treated in 1944, 60 percent was copper (two-fifths of which

was old tailings), 14 percent gold, 10 percent zinc-copper, 7 percent zinc, 4 percent lead, 4 percent zinc-lead, and the remainder dry gold-silver and dry silver. Substantial quantities of copper and silver and some gold and lead were recovered from ore valued chiefly for tungsten and molybdenum; this ore is not included in the tonnage figures, but the metals are included in the metal totals.

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore and old tailings sold or treated in California in 1944, with content in terms of recovered metals

Source	Material sold or treated		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	Short tons	Short tons	Fine ounces	Fine ounces	Pounds	Pounds	Pounds
Dry and siliceous gold ore.....	127,588	3,670	31,942	57,237	495,600	7,800	.....
Dry and siliceous gold-silver ore.....	1,255	1,326	224	5,894	15,100	169,100	.....
Dry silver ore.....	1,758	.....	91	11,645	600	.....	.....
Flotation ore.....	130,601	4,996	32,257	74,776	511,300	176,900	.....
Flotation concentrate.....	332,353	224,025	3,399	24,411	20,965,600	.....	.....
Flotation tailings.....	33,993	5,088	1,948	299,599	68,600	8,078,500	186,400
Flotation concentrate.....	69,204	.....	3,988	194,120	1,258,000	504,000	11,850,600
Flotation tailings.....	90,059	.....	464	85,150	2,528,000	25,100	2,379,600
Flotation concentrate.....	35,634	.....	268	96,349	110,500	2,579,500	2,494,000
Total, lode mines.....	691,844	234,109	42,324	774,405	25,442,000	11,364,000	16,910,000
Total, placer.....	.....	.....	75,049	4,531	.....	.....	.....
Total, 1943.....	691,844	234,109	117,373	778,936	25,442,000	11,364,000	16,910,000
Total, 1944.....	581,186	158,770	148,328	609,675	17,524,000	11,640,000	3,712,000

¹ Excludes tungsten ore.

² Excludes metal recovered from tungsten ore.

³ Excludes 61,100 pounds from precipitates.

⁴ Excludes 65,000 pounds from precipitates.

METALLURGIC INDUSTRY

During 1944, 79 percent of the total ore and old tailings handled was treated at concentrating mills, 14 percent was treated at amalgamation and cyanidation mills, and 7 percent was shipped for direct smelting. Smelters also received 86,879 tons of flotation concentrates and 74 tons of gravity concentrates from California mine operators. Comparing 1944 with 1943, material treated at cyanidation mills decreased 86 percent, the quantity of material amalgamated decreased 37 percent, and the quantity of crude ore and old tailings smelted decreased 5 percent. The quantities of ore and old tailings concentrated, however, increased 169 percent; the tonnage of tungsten ore concentrated is not included in 1943 or 1944.

Because of unusual conditions in the California gold industry in 1943 and 1944, quicksilver- and cyanide-consumption data at mills were not representative of the industry.

The Selby lead smelter of the American Smelting & Refining Co. was the only custom plant that treated gold, silver, copper, lead, or zinc ores in California in 1944. Some ore and concentrates were shipped to out-of-State smelters. Most of the ore produced in the State, however, was treated in company-owned metallurgical plants at the mines.

Mine production of metals in California in 1944, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
Ore and old tailings amalgamated	Short tons 125,193	Fine ounces 14,752	Fine ounces 2,722	Pounds	Pounds	Pounds
Ore, old tailings, and concentrates cyanided	27,648	9,242	12,791			
Concentrates smelted:						
Flotation	86,879	14,492	403,777	24,363,200	1,812,700	15,357,100
Gravity	74	398	129		2,200	
Ore and old tailings smelted	62,503	3,440	354,986	1,017,700	9,549,100	1,552,900
Precipitates			61,100			
Total, lode mines		42,324	774,405	25,442,000	11,364,000	16,910,000
Total, placers		75,049	4,531			
		117,373	778,936	25,442,000	11,364,000	16,910,000
Total, 1943		148,328	609,075	17,524,000	11,640,000	3,712,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in California in 1944, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal				
	Ore ¹	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	Short tons	Fine ounces	Fine ounces	Short tons	Fine ounces	Fine ounces	Pounds	Pounds
Amador	520		121	19					
Butte	2		6						
Calaveras	1,328		251	58	9	33	5		
Eldorado	350		21	14					
Inyo	36		8	1	1	9	9		200
Kern	406		104	50					
Los Angeles	120		2	3					
Mariposa	2,855	35	2,153	566	119	1,340	407		
Nevada	42,457		8,113	1,200					
Plumas	200		18	3					
San Diego	10		2	2					
Shasta	1,208		541	142	17	81	25		
Sierra	3,077		2,776	523					
Siskiyou	226		94	8					
Trinity	13		18	7					
Tuolumne	72,350		524	126	2,076	5,194	2,712	14,000	
	125,158	35	14,752	2,722	2,222	6,657	3,158	14,000	200
Total, 1943	198,903	185	12,145	3,956	4,324	14,781	4,932	6,200	200

CYANIDATION MILLS

Amador		74	179	35	64	356	115		2,000
Inyo		15	4	9					
Kern	1,010	2,846	1,118	716					
Nevada	23,303		7,836	11,539					
San Bernardino		400	105	492					
	24,313	3,335	9,242	12,791	64	356	115		2,000
Total, 1943	47,348	155,081	8,039	16,390	2,217	12,138	95,624	4,700	17,800
Grand total:									
1944	149,471	3,370	23,994	15,513	2,286	7,013	3,273	14,000	2,200
1943	246,251	155,266	20,184	20,346	6,541	26,919	100,556	10,900	18,000

¹ Figures under "Ore" include both raw ore and concentrates amalgamated or cyanided, but not raw ore concentrated before amalgamation or cyanidation of concentrates.

The production of metals from concentrating mills in California in 1944, by counties, in terms of recovered metals

County	Material treated		Concentrates smelted and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	<i>Short tons</i>	<i>Short tons</i>	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Alameda	14, 297		3, 403	563	10, 897	486, 000	54, 000	2, 888, 000
Calaveras	118, 552	220, 282	14, 670	1, 560	58, 011	4, 902, 000	178, 000	2, 172, 000
Colusa	1, 400		93	30	623	52, 000		
El Dorado	27, 262		3, 373	127	100, 707	1, 481, 400	1, 259, 100	1, 117, 900
Mariposa	34, 267		7, 749	1, 893	113, 573	112, 000	238, 000	6, 692, 000
Merced	666		156	51	16, 318	2, 000	34, 000	98, 000
Monterey	106		2	1	1, 090	3, 800	24, 500	9, 600
San Bernardino	90, 059		13, 733	464	85, 150	2, 528, 000	25, 100	2, 379, 600
San Diego	227, 021		41, 488	3, 188	14, 264	15, 782, 000		
Total 1944	513, 630	220, 282	84, 667	17, 877	140, 633	24, 349, 200	1, 812, 700	15, 357, 100
	269, 631	3, 200	46, 173	13, 445	145, 724	116, 272, 800	1, 679, 910	2, 307, 300

Includes concentrates and metals from tungsten ore not included in material treated.

The metal content of concentrates produced from ores mined in California in 1944, by classes of concentrates

Class of concentrates	Concentrates	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Gold	2, 286	7, 013	3, 273	23, 385	2, 280	
Silver	66, 054	5, 132	164, 138	24, 634, 727	188, 743	466, 202
Copper	1, 480	221	76, 454	68, 994	1, 270, 760	142, 270
Lead	761	1, 013	69, 798	186, 902	243, 216	319, 780
Zinc	16, 016	1, 454	88, 324	294, 611	277, 129	16, 712, 710
Other	366	57	1, 919	81, 458	3, 521	200, 845
Total 1944	86, 953	14, 890	403, 906	25, 290, 077	1, 985, 649	17, 841, 807
	52, 714	30, 364	246, 280	16, 820, 957	741, 420	2, 754, 591

The production of metals from California concentrates shipped to smelters in 1944, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Alameda	64	356	115		2, 000	
Calaveras	3, 403	563	10, 897	486, 000	54, 000	2, 888, 000
Colusa	14, 679	1, 593	58, 016	4, 902, 000	178, 000	2, 172, 000
El Dorado	93	30	623	52, 000		
Mariposa	3, 374	136	100, 716	481, 400	1, 259, 300	1, 117, 900
Merced	7, 868	3, 233	113, 980	112, 000	238, 000	6, 692, 000
Monterey	156	51	16, 318	2, 000	34, 000	98, 000
San Bernardino	2	1	1, 090	3, 800	24, 500	9, 600
San Diego	13, 750	545	85, 175	2, 528, 000	25, 100	2, 379, 600
San Francisco	41, 488	3, 188	14, 264	15, 782, 000		
Total 1944	2, 076	5, 194	2, 712	14, 000		
	86, 953	14, 890	403, 906	24, 363, 200	1, 814, 900	15, 357, 100
	52, 714	30, 364	246, 280	16, 283, 700	697, 910	2, 307, 300

BY CLASSES OF CONCENTRATES

		Gold	Silver	Copper	Lead	Zinc
	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Gold	2, 286	7, 013	3, 273	14, 000	2, 200	
Silver	66, 054	5, 132	164, 138	23, 828, 100	143, 100	186, 000
Copper	1, 480	221	76, 454	60, 400	1, 219, 200	700
Lead	761	1, 013	69, 798	112, 000	238, 000	
Zinc	16, 016	1, 454	88, 324	279, 700	209, 000	15, 041, 900
Other	256	57	1, 919	69, 000	3, 400	128, 500
Total 1944	86, 953	14, 890	403, 906	24, 363, 200	1, 814, 900	15, 357, 100

Gross metal content of California crude ore and old tailings shipped to smelters in 1944, by classes of material

Class of ore	Material shipped		Gross metal content				
	Ore	Old tailings	Gold	Silver	Copper	Lead	Zinc
	<i>Short tons</i>	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Dry gold.....	1,420	300	876	2,458	24,021	5,870	-----
Dry gold-silver.....	1,255	1,326	224	5,894	21,159	178,483	-----
Dry silver.....	1,758	-----	91	11,645	771	551	-----
Copper.....	5,354	3,743	102	4,844	1906,053	-----	-----
Lead.....	33,993	5,088	1,948	299,599	104,772	8,342,119	1,969,011
Zinc-lead.....	8,266	-----	199	30,546	100,457	1,317,946	1,947,381
Total, 1943.....	52,046	10,457	3,440	354,986	11,157,233	9,844,969	3,916,400
	65,304	304	8,355	336,457	11,360,530	11,508,528	5,324,300

¹ Includes 61,100 pounds contained in precipitates.

² Includes 65,096 pounds contained in precipitates.

Mine production of metals from California crude ore and old tailings shipped to smelters in 1944, in terms of recovered metals

BY COUNTIES

	Material shipped		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	<i>Short tons</i>	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Alpine.....	9	-----	15	671	-----	-----	-----
Amador.....	4,334	-----	35	1,967	474,000	-----	-----
Eldorado.....	16	-----	7	166	-----	-----	-----
Inyo.....	39,073	6,414	2,423	310,277	88,600	8,782,700	634,100
Kern.....	23	-----	4	280	-----	8,000	8,000
Madera.....	68	-----	20	180	174,000	-----	-----
Mariposa.....	155	-----	87	1,059	-----	-----	-----
Placer.....	-----	154	43	360	-----	-----	-----
Plumas.....	5	-----	13	8	-----	-----	-----
San Bernardino.....	5,819	3,889	684	25,639	386,200	283,500	226,400
Shasta.....	2,544	-----	109	14,379	56,000	474,900	684,400
Total, 1943.....	52,046	10,457	3,440	354,986	11,078,800	9,549,100	1,552,900
	65,304	304	8,355	336,457	11,240,300	10,942,090	1,404,700

BY CLASSES OF MATERIAL

Dry gold.....	1,420	300	876	2,458	22,200	5,600	-----
Dry gold-silver.....	1,255	1,326	224	5,894	15,100	169,100	-----
Dry silver.....	1,758	-----	91	11,645	600	-----	-----
Copper.....	5,354	3,743	102	4,844	1887,600	-----	-----
Lead.....	33,993	5,088	1,948	299,599	68,600	8,078,500	192,800
Zinc-lead.....	8,266	-----	199	30,546	84,700	1,295,900	1,360,100
	52,046	10,457	3,440	354,986	11,078,800	9,549,100	1,552,900

¹ Includes 61,100 pounds from precipitates.

² Includes 65,000 pounds from precipitates.

MINES PRODUCING GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA, 1914. THE TOTALS OF MINERAL PRODUCTION IN 1914.

County and district	Mines producing		Ore and tailings	Gold			Total	Silver (bars and pieces)	Copper	Lead	Zinc	Total value
	Lode	Placer		Placer	Fine ounces	Fine ounces						
Alpine County: Monitor	1		Short tons 9			15						\$1,002
Amador County:												
Mother Lode	1		4,327			29		1,996				96,403
Butte County:												
Mother Lode	4	(*)	601		43	705		177	474,000	2,000		24,961
Butte County:												
Butte Creek	1	2	2		86	92		14				3,230
Enterprise	1	1	1		48	48		7				1,685
Forbestown		(*)			45	45		7				1,580
Oroville		5			9,859	9,859		907				345,710
Yankee Hill	1	(*)	14,297		563	591		10,900	486,000	54,000	2,888,000	427,598
Calaveras County:												
Camarache	1				17	17		3				597
Campo Seco	1		13,033		609	609		27,332	458,000	67,000	1,423,700	270,243
Copperopolis	2		318,860		79	79		4,980	4,244,000			579,033
East Belt	1	(*)	3		2	22		1				771
Jenny Lind	1		200		50	50		31				1,772
Mother Lode	2	2	1,125		52	284		35				9,965
West Belt	2		6,941		872	872		25,999	200,000	111,000	748,300	170,194
Del Norte County: French Hill	1				3	3						105
Eldorado County:												
East Belt	1	1	350		21	29		15				1,026
Mother Lode	1	(*)	1,400		30	46		626	52,000			9,075
West Belt	1		10		7	7		166				363
Fresno County: Friant												
Humboldt County: Orleans												
Inyo County:												
Cerro Gordo	2											
Coso	4		1,996		11	11		13,815	5,400	350,400		39,600
Moccasin	1		49,251		183	183		252,900	53,200	5,218,900	1,109,100	738,051
Resting Springs	2		251		26	26		2,620	1,200	31,100		7,023
Shute Range	1		14,593		1,810	1,810		92,818	21,000	3,599,100	186,400	441,367
Ubechee	1		5,962		233	233		9,613	23,600	639,700	334,800	107,520
Union	1		194		3	3		1,205		79,300		7,414
Wild Rose	1		188		240	240		637	200	6,600		9,328
Kern County:												
Amalie	1		44		1	1		173		13,900	15,200	3,003
China (Grade)	1	(*)	22		2	2		222		8,000	8,000	1,780
Green Mountain	1		240		56	56		31				1,982
Keyes	1		13		11	11		7				390
Mojave	2		1,011		975	975		727				34,642
Randsburg	4		2,999		182	245		73				8,627

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1944, by counties and districts, in terms of recovered metals ¹—Continued

County and district ¹	Mines producing ²		Ore and old tailings	Gold			Silver (lode and placer) ³	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
Los Angeles County:			Short tons	Fine ounces	Fine ounces	Fine ounces	Fine ounces	Pounds	Pounds	Pounds	
Iron Mountain.....	1	2	120	2	83	85	3				\$72
San Gabriel.....	3		68	20	20	20	14	10 74,000			2,915
Madera County: Daulton.....	3	1	471	382	4	386	53				10,818
Mariposa County:			36,511	4,633		4,633	115,470				13,548
East Belt.....	4		330	458	12	470	85	112,000	238,000	6,692,000	1,041,315
Hunter Valley.....	5	(⁴)			5	5					16,510
Mother Lode.....					9		3				175
Merced County: Snelling.....	1										317
Mono County: Mammoth Lakes.....											
Nevada County:											
French Corral.....	(11)	(⁴)	(11)		30	30	6				1,054
Grass Valley-Nevada City.....	1		3	(11)	27	12 27	12 3				12 947
Washington.....		(⁴)			23	23	1				71
You Bet.....			666	51		51	16,318	2,000	34,000	98,000	808
Orange County: Santa Rosa.....	1										27,551
Placer County:											
Auburn.....	1	(⁴)	154	43	7	50	362				2,007
Butcher Ranch.....		1			67	67	8				2,351
Foresthill.....		(⁴)			43	43	5				1,509
Iowa Hill.....		1			47	47	5				1,649
Last Chance.....		3			165	165	17				5,787
Michigan Bluff.....		(⁴)			20	20	2				701
Ophir.....		(⁴)			15	15	2				526
Plumas County:											
Genesee.....		1			39	39	7				1,370
Johnsville.....	2		205	31	13	31	11				1,093
La Porte.....		1			38	38	2				456
Quincy.....		(⁴)			23,789	23,789	4				1,333
Sacramento County: Folsom.....		3					1,118				833,410
San Bernardino County:											
Bellville.....	2		301	33		33	204	6,200			2,137
Buckeye.....	2		665	420		420	966	5,400			16,116
Calico.....	1		50				252				1,075
Clark Mountain.....	2		5,524	44		44	11,229	306,000	244,600	202,500	93,488
Ivanpah.....	1		107				111		12,000	17,500	3,082
Monumental.....	1	1	12	7		7	7	800			358
New York Mountains.....	1		139	2		2	1,741	7,800	39,600	16,000	7,353
Randsburg.....	2	1	2,056	106	129	325	11,766				19,742
Solo.....	1		9	24		24	7				845
Whipple Mountains.....	4		412	28		28	478	11,600			2,886
San Diego County: Pine Valley.....	1		10	2		2	2				71
Shasta County:											
Flat Creek.....											

[illegible]

¹ Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; others producing listed in footnote 13 and their output included under "Other districts."

² Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

³ Source of total silver as follows: 774,405 ounces from lode mines and 4,531 ounces from placers.

Counties.
 † Output from property not classed as a "mine."

6 Comanche district lies in Amador, Calaveras, and San Joaquin Counties.
7 East Belt district lies in Amador, Calaveras, El Dorado, Mariposa, and Tuolumne Counties.

Counties.

^a West Belt district lies in Calaveras and Eldorado Counties.
Dandelion district lies in Kern and San Bernardino Counties.

¹⁰ Includes 61,100 pounds from precipitates.

² Exclusive of lode output, which is included under "Other districts."

¹³ Includes following: Bishop Creek and South Park districts in Valley-Nevada City (code) in Nevada County; Exchequer in San

amanche in San Joaquin County; Alleghany (lode) in Sierra County

¹⁴ Excludes tungsten ore.

* Includes metal recovered from tungsten ore.

AMADOR COUNTY

Ione district.—The Winston Copper Co. operated the Newton mine throughout 1944 and shipped 4,327 tons of copper ore containing 29 ounces of gold, 1,966 ounces of silver, and 483,488 pounds of copper to a smelter.

Mouher Lode district.—The Nevada Wabash Mining Co. undertook development at the Nevada Wabash mine on February 15, 1944, and treated gold ore by amalgamation. The Central Eureka Mining Co. recovered a small quantity of gold from a mill clean-up at the Old Eureka and Central Eureka mines.

BUTTE COUNTY

Oroville district.—The Golden Feather Dredging Co. operated a dragline dredge on the Feather River channel at Oroville during 1944, but work was suspended before the end of the year; an electric dragline excavator equipped with a 5-cubic yard bucket was used. This operation was carried on under a special grant from the War Production Board because gravel cleared from the Feather River channel was stacked as a levee to protect the town of Oroville. The Morris Ravine Mining Co. produced 1,100 cubic yards of gravel at the Morris Ravine drift mine while maintaining the property for postwar operation; 181 ounces of gold and 18 ounces of silver were recovered. The Oroville Gold Dredging Co. operated a connected-bucket dredge equipped with 72 $8\frac{1}{2}$ -cubic foot buckets on Feather River 9 miles southwest of Oroville from January 1 to November 2.

Yankee Hill district.—Hoeftling Bros. operated the Big Bend mine throughout 1944 and trucked 14,297 tons of zinc ore to the Surcease mill, which had been converted from a gold mill to treat Big Bend ore; 701 tons of copper concentrate (containing 215 ounces of gold, 1,932 ounces of silver, 360,485 pounds of copper, 28,928 pounds of lead, and 290,100 pounds of zinc) and 2,702 tons of zinc concentrate (containing 348 ounces of gold, 8,965 ounces of silver, 189,013 pounds of copper, 26,983 pounds of lead, and 3,003,115 pounds of zinc) were recovered by flotation and shipped to smelters. The company carried on extensive exploration in the area.

CALAVERAS COUNTY

Campo Seco district.—Eagle Shawmut Mine completed the unwatering of the Penn mine in October 1943 and began shipping zinc-copper ore to the company mill at the Eagle Shawmut mine near Jacksonville in May 1944. Production was increased progressively during 1944, but further expansion was still in prospect at the end of the year. A section of the Eagle Shawmut gold mill was reequipped to treat the Penn mine ore.

Copperopolis district.—The Keystone mine was operated throughout 1944 by the Keystone Copper Corp., successor to the Keystone Copper Co.; 98,578 tons of copper ore were trucked to the nearby redesigned Mountain King flotation mill, and 7,364 tons of copper concentrates containing 54 ounces of gold, 3,195 ounces of silver, and 3,836,700 pounds of copper were shipped to a smelter. The company was the second-largest copper producer in the State, as in 1943. The Pacific Mining Co. operated a flotation plant on old tailings at the Union mine throughout 1944. The quantity of material treated and the recovery of copper concentrate increased progressively during the year.

Jenny Lind district.—Lessees amalgamated gold ore that was produced at the Royal mine during 1944.

Mother Lode district.—Clean-up material at the Carson Hill operation yielded a small quantity of gold.

West Belt district.—E. A. Vogt worked the Collier mine from January 1 to July 15; 2,604 tons of zinc ore were shipped to a concentrator smelter. The ore contained 220 ounces of gold, 9,949 ounces of silver, 7,799 pounds of copper, 52,579 pounds of lead, and 568,491 pounds of zinc. G. Ivan Smith worked the Quail Hill mine until operations were suspended near midyear. Zinc ore was shipped to a concentrator smelter.

ELDORADO COUNTY

Mother Lode district.—Pioneer-Lilyama Mines carried on a mine-development and mill-construction program at the Pioneer-Lilyama mine; 1,400 tons of copper ore were treated in the 250-ton flotation mill, and 93 tons of concentrates containing 30 ounces of gold, 623 ounces of silver, and 54,028 pounds of copper were shipped to a smelter.

FRESNO COUNTY

Friant district.—The Grant Service Rock Co., Consolidated, recovered 155 ounces of gold and 18 ounces of silver in preparing 189,458 tons of sand and gravel for concrete aggregate.

INYO COUNTY

Bishop Creek district.—The United States Vanadium Corp. produced, by flotation, a copper concentrate containing a substantial quantity of silver per ton as a byproduct from ore treated primarily for tungsten.

Cerro Gordo district.—Imperial Metals, Inc., conducted an exploration and development campaign at the Cerro Gordo mine throughout 1944 and shipped argentiferous lead ore to a smelter; the work was under the direction of the management of the Golden Queen Mining Co.

Coso district.—The Darwin group of mines, which includes the Defiance, Independence, Essex, Thompson, Lucky Jim, Lane, Promontory, and Columbia claims, was operated by Darwin Mines (Arthur J. Theis, trustee) throughout 1944; 27,237 tons of lead-zinc ore were treated in the company 125-ton flotation mill, and 1,186 tons of lead concentrate (containing 52 ounces of gold, 53,037 ounces of silver, 13,123 pounds of copper, 1,175,081 pounds of lead, and 5,377 pounds of zinc) and 1,351 tons of zinc concentrate (containing 16 ounces of gold, 11,606 ounces of silver, 10,680 pounds of copper, 140,180 pounds of lead, and 1,232,322 pounds of zinc) were shipped to a smelter. In addition, 10,883 tons of lead ore containing 106 ounces of gold, 126,714 ounces of silver, 40,796 pounds of copper, and 2,883,034 pounds of lead were shipped for direct smelting. Company operations were curtailed by a chronic labor shortage. L. D. Foreman & Co. shipped material to a smelter from the Last Chance old slag dump and from the Wallace old slag dump. Louis Warnken, Jr., shipped old tailings to a smelter.

Resting Springs district.—Shoshone Mines, Inc., operated the Columbia No. 2 mine throughout 1944; 14,593 tons of lead ore containing 1,810 ounces of gold, 92,818 ounces of silver, 31,634 pounds of copper, 3,701,492 pounds of lead, and 1,959,480 pounds of zinc were shipped to smelters.

Slate Range district.—Damon & Damon worked the Gold Bottom and Ophir mines throughout 1944; 1,163 tons of gold-silver ore and 1,326 tons of gold-silver old tailings (containing 171 ounces of gold, 4,113 ounces of silver, 21,090 pounds of copper, and 178,483 pounds of lead) and 3,473 tons of zinc-lead ore (containing 62 ounces of gold, 5,500 ounces of silver, 10,018 pounds of copper, 477,756 pounds of lead, and 523,096 pounds of zinc) were shipped to a smelter. The moving of the Mineral Reduction Co. cyanide-flotation mill from Benton Station and its reconstruction at the Ophir mine as a 150-ton concentration and flotation mill were continued during the year.

South Park district.—The Southwest Lead & Zinc Co. operated the Honolulu-Big Horn (Gibraltar) mine in 1944 from January 1 until August, when the property was quitclaimed to its owner, Frank Long.

Union district.—T. L. Bright shipped gold ore to a smelter from the Reward (Brown Monster) mine.

Wild Rose district.—Silas Ness shipped zinc-lead ore from the Big Four mine to a smelter.

KERN COUNTY

Amalie district.—The Pacific-Atlantic Metals Corp. reopened the Black Hawk mine in Stud Horse Gulch during 1944 and shipped a small quantity of zinc-lead ore to a smelter; operations were suspended before the end of the year.

Green Mountain district.—Mattie Moreland amalgamated ore from the Lone Star mine during an operating period from May 1 to October 27, 1944.

Mojave district.—During a brief operating period Burton Bros., Inc., cyanided a small quantity of gold ore from the Tropico mine.

Randsburg district.—The Butte Lode Mining Co. cyanided 2,846 tons of old tailings in the Butte Lode mine, from which 145 ounces of gold and 47 ounces of silver were recovered.

LOS ANGELES COUNTY

San Gabriel district.—The Consolidated Rock Products Co. recovered gold and silver as byproducts from its Largo Plant No. 10 gravel-washing operation. Robert A. Riggs recovered 29 ounces of gold and 4 ounces of silver as byproducts in the preparation of sand and gravel for concrete aggregate.

MADERA COUNTY

Daulton district.—The West Lode Reduction Co. recovered copper cement containing 61,100 pounds of copper from mine water pumped from the Daulton mine during operations from January 1 to December 12, 1944.

MARIPOSA COUNTY

East Belt district.—A. E. Clark worked the Our Chance mine from January 14 to April 1 and recovered 54 ounces of gold and 10 ounces of silver from 165 tons of ore amalgamated. Schroeder, Odgers, &

Schroeder worked the Schroeder group throughout 1944 and amalgamated 196 tons of ore with a recovery of 320 ounces of gold and 6 ounces of silver.

Hunter Valley district.—Lessees worked the B. A. B. (Akcoz) mine throughout 1944 and shipped 82 tons of gold-silver ore containing 36 ounces of gold, 1,052 ounces of silver, and 43 pounds of copper to a smelter. Red Cloud Mines, Inc., an operating subsidiary of the Idaho Mining Co. of Wallace, Idaho, worked the Blue Moon mine throughout the year; 34,267 tons of zinc ore treated in the company flotation mill (a converted and enlarged gold mill formerly used to treat gold ore from the Jenny Lind mine) yielded 761 tons of gold-copper concentrate containing 1,013 ounces of gold, 69,798 ounces of silver, 186,902 pounds of copper, 243,216 pounds of lead, and 319,780 pounds of zinc and 6,988 tons of zinc concentrate containing 880 ounces of gold, 43,775 ounces of silver, 48,440 pounds of lead, and 6,435,300 pounds of zinc. Company operations were severely curtailed by a chronic shortage of labor. The Mount Gaines Mining Co. worked the Mount Gaines mine on a restricted basis under a grant from the War Production Board and amalgamated 1152 tons of ore, from which bullion containing 1,612 ounces of gold and 487 ounces of silver and 67 tons of concentrates containing 1,089 ounces of gold and 356 ounces of silver were recovered.

Mother Lode district.—The Ruth-Bobby Mining Co. worked the Dry Creek lode from June 8 to December 31 and shipped 73 tons of ore containing 51 ounces of gold and 7 ounces of silver to a smelter. A small quantity of gold was recovered from a clean-up, by the Pacific Mining Co., at the Pine Tree and Josephine mines.

NEVADA COUNTY

Grass Valley-Nevada City district.—Under a grant by the War Production Board the Empire Star Mines Co., Ltd., resumed operations at the Empire Star group in March 1944 and operated until December 31. The grant limited employment by the company to 75 men, which curtailed production far below that of prewar years. The Idaho Maryland Mines Corp. was permitted to hire up to 200 miners under a War Production Board grant issued in March, but the company experienced difficulty in developing a working staff of this size. Most of the operations were carried on in the Brunswick section of the property.

ORANGE COUNTY

Santa Rosa district.—The Blue Light Silver Mines Co. worked the Silverado mine on a curtailed basis throughout 1944 owing to labor shortage; 666 tons of zinc ore containing 57 ounces of gold, 17,966 ounces of silver, 4,031 pounds of copper, 37,982 pounds of lead, and 38,419 pounds of zinc were shipped to a concentrator smelter.

PLACER COUNTY

Last Chance district.—The Red Star Mining Co., Inc., produced 69 ounces of gold and 6 ounces of silver during hydraulic test operations at the Red Star mine in 1944.

SACRAMENTO COUNTY

Folsom district.—Pacific Coast Aggregates, Inc., and the Fair Oak Gravel Co. produced 220 ounces of gold and 19 ounces of silver and byproducts during the preparation of gravel for concrete aggregates during 1944. The Natomas Co.—permitted to operate two units in its fleet of seven connected-bucket dredges—worked on this limited scale throughout the year. C. M. Craig produced gold as a byproduct of a gravel-washing plant.

SAN BERNARDINO COUNTY

Buckeye district.—Roosevelt Mines, Inc., shipped gold ore to a smelter from the Roosevelt mine.

Clark Mountain district.—L. D. Foreman & Co. shipped old slag from the Copper World smelter site for re-treatment during 1944. Dunton-Ray & Greenwood worked the Mohawk mine and shipped zinc-lead ore to a smelter.

Erchequer district.—The Dutch Oven Mining Co. worked the Von Trigger mine throughout 1944 and shipped copper ore to a smelter.

New York Mountains district.—The California Sulphur Co. produced lead-zinc ore at the Sagamore mine.

Randsburg district.—Hoeftling Bros. recovered placer gold as a byproduct of an operation carried on during 1944, principally for scheelite, at the Spud Patch mine. C. O. Mittendorf shipped silver ore to a smelter from the Coyote mine.

SAN JOAQUIN COUNTY

Camanche district.—The Gold Hill Dredging Co. was permitted to operate one dredge under special grant from the War Production Board during 1944 and elected to operate its Lower Comanche dredge. This electric dredge was equipped with 87 8½-cubic foot buckets.

SHASTA COUNTY

Flat Creek district.—The Mountain Copper Co., Ltd., mined zinc-copper ore from the Mattie ore body in the Hornet mine throughout 1944; 90,059 tons of ore were treated in the company 300-ton flotation mill, and 10,966 tons of copper concentrates (containing 413 ounces of gold, 74,138 ounces of silver, 2,557,500 pounds of copper, and 27,798 pounds of lead) and 2,767 tons of zinc concentrates (containing 51 ounces of gold, 11,012 ounces of silver, 50,497 pounds of copper, 11,340 pounds of lead, and 2,643,600 pounds of zinc) were recovered. Old flue dust from earlier smelting operations in the Shasta copper belt were recovered from the area where the recently completed Shasta Dam was causing a lake to form. Part of the material was shipped to a slag-fuming plant, principally for the recovery of zinc, and part was stored in an area beyond the prospective shore line of the growing lake.

French Gulch district.—The St. Jude Mining Co. worked the St. Jude mine and treated gold ore by amalgamation and concentration.

Redding district.—The Columbia Construction Co., Inc., recovered 491 ounces of gold and 52 ounces of silver as byproducts during the production of 582,158 tons of sand and gravel for use in the construction of Shasta Dam; with completion of Shasta Dam the operation

was suspended June 22, 1944, and the gravel-washing plant was dismantled.

SIERRA COUNTY

Allegany district.—The American Hill Mining Co. worked the American Hill and Pilgrim Annex mine during 1944 and treated gold ore by amalgamation. Original Sixteen to One Mine, Inc., carried on a limited operation throughout the year under a grant issued by the War Production Board. Gold ore was treated by amalgamation.

Downieville district.—C. L. Best produced a small quantity of gold from gravel mined at the Ruby drift mine. The Alpha Hardware & Supply Co. treated a small quantity of gold ore by amalgamation at the Brush Creek mine during the first 3 months of 1944. Later the property was leased to A. L. Merritt.

Pike (Slate Range) district.—W. C. Ennis worked the Bowman mine from June 5 to October 1 and recovered 60 ounces of gold and 7 ounces of silver by amalgamation of 180 tons of ore.

SISKIYOU COUNTY

Klamath River district.—The Gray Eagle Copper Co. operated the Eakin or Gray Eagle mine throughout 1944; 227,021 tons of copper ore treated in the company 700-ton flotation mill yielded 41,488 tons of concentrates (containing 3,188 ounces of gold, 14,264 ounces of silver, and 16,293,158 pounds of copper) which were shipped to a smelter. This operation produced 62 percent of the State output of copper in 1944.

Liberty district.—Judge Hydraulic Mine carried on hydraulicking at the Judge mine from January 1 to May 25. Alex Markon worked the Anna Johnson and Surprise quartz mines during the year.

Scott Bar district.—George A. Milne carried on hydraulicking at the Milne mine during 1944.

STANISLAUS COUNTY

La Grange district.—The Tuolumne Gold Dredging Corp. operated a connected-bucket dredge equipped with 100 12-cubic foot buckets throughout 1944 on a one-shift basis.

TRINITY COUNTY

Junction City district.—G. H. Bergin carried on hydraulicking from February 6, 1944, at the Canyon Placers mine. Chapman & Sons hydraulicked 20,000 cubic yards of gravel at the Chapman and Fisher mine and recovered 90 ounces of gold and 8 ounces of silver between March 1 and July 1. The Goldfield Consolidated Mines Co. worked the Red Hill mine by hydraulicking during 1944.

Weaverville district.—W. E. Woodbury conducted a hydraulic operation at the Rex mine.

TUOLUMNE COUNTY

East Belt district.—Edwin Harper worked intermittently at the Eureka pocket mine during 1944.

Mother Lode district.—In addition to the zinc-copper ore trucked from the Penn mine in Calaveras County, Miller & Clemson (Eagle

Shawmut Mine) treated gold ore produced at the Eagle Shawmut mine; 72,300 tons of gold ore treated by amalgamation and flotation yielded bullion (containing 388 ounces of gold and 105 ounces of silver) and 2,076 tons of concentrate (containing 5,194 ounces of gold, 2,712 ounces of silver, and 23,321 pounds of copper).

YUBA COUNTY

Camptonville district.—Experimental hydraulicking by H. M. Allen at the Joubert mine produced 47 ounces of gold and 3 ounces of silver from 7,900 cubic yards of gravel.

Yuba River district.—Yuba Consolidated Gold Fields was permitted to operate two of its fleet of six dredges from January 1 to December 31, 1944, under a War Production Board grant. The dredges in operation were both of Yuba type and used electric power; one had 126 and the other 135 18-cubic foot buckets.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE CENTRAL STATES

(MINE REPORT)

By A. J. MARTIN

SUMMARY OUTLINE

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SUMMARY

With most of the war projects for expanding mine production of copper, lead, and zinc in the Central States completed before the beginning of 1944, activity during the year centered chiefly on maintaining output from established operations. The labor shortage became acute in some districts after midyear, and the total production of each of these three metals was less in 1944 than in 1943. The decreases in copper and zinc were small and did not disturb war procurement agencies, as reserve stocks of both metals increased during the year; the decrease (7 percent) in lead, however, caused concern owing to the decline in stocks of that metal. In December the War Production Board restricted the use of lead for most civilian purposes and urged mine operators to take steps to increase production. The disseminated-lead district of Southeastern Missouri is the largest lead-producing district in the United States. The bulk of the district output comes from the large, well-developed, mechanized mines of the St. Joseph Lead Co. The rise in zinc consumption late in the year, which caused heavy withdrawals from slab zinc stocks, encouraged zinc-mine operators in their efforts to maintain production rates; also, the Surplus Property Disposal Act of 1944 removed some of the uncertainty that prevailed concerning the short-term outlook for the mining industry. Although ceiling market prices and general bonus-price levels previously set for copper, lead, and zinc were not changed in 1944, the bonus prices paid for the output of some of the individual mines varied as a result of quota adjustments, and the average over-all prices increased slightly. The Lake Superior district in Michigan produced 93 percent of the Central States output of copper, the Southeastern Missouri district 84 percent of the lead, and the Tri-State district (Kansas, Oklahoma, and Southwestern Missouri) 89 percent of the zinc and 14 percent of the lead. The Southeastern Missouri district also produced some copper and zinc. Other districts producing zinc and lead were Wisconsin-Northern Illinois (Upper

Mississippi Valley), Kentucky-Southern Illinois, and Central Missouri; Northern Arkansas produced some zinc.

The silver produced in the Central States is a minor byproduct derived from some of the base-metal ores. No mine production of gold was reported in the Central States from 1941 to 1944, inclusive.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ³	Zinc ³
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940.....	\$35.00	\$0.711+	\$0.113	\$0.050	\$0.063
1941.....	35.00	711+	.118	.057	.075
1942.....	35.00	711+	.121	.067	.093
1943.....	35.00	711+	.130	.075	.108
1944.....	35.00	711+	.135	.080	.114

¹ Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price includes bonus payments by Metals Reserve Co. for overquota production.

*\$0.71111111.

Mine production of gold, silver, copper, lead, and zinc in the Central States, 1940-44, in terms of recovered metals

Year	Mines producing	Ore and old tailings (short tons)	Gold		Silver	
			Fine ounces	Value	Fine ounces	Value
1940.....	416	25,532,085	15	\$175	353,737	\$251,546
1941.....	447	28,959,189	-----	-----	448,824	319,164
1942.....	502	30,726,994	-----	-----	130,894	93,073
1943.....	407	32,673,764	-----	-----	161,917	115,141
1944.....	386	34,240,455	-----	-----	148,898	105,883

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
1940.....	91,766,000	\$10,369,558	267,587	\$20,758,700	244,976	\$30,866,976	\$62,246,955
1941.....	95,680,000	11,290,240	269,362	23,867,268	276,006	41,400,900	76,877,572
1942.....	93,958,000	11,368,918	235,229	31,520,686	258,181	48,021,666	91,004,343
1943.....	96,208,000	12,507,040	217,060	32,559,000	222,707	48,104,712	93,285,893
1944.....	91,446,000	12,345,210	201,577	32,252,320	214,949	49,008,372	93,711,785

¹ From placer prospecting.

Silver.—The output of recoverable silver from ores mined in the Central States in 1944 comprised 86,279 ounces derived from refining some of the lead bullion recovered from Southeastern Missouri lead ores, 54,218 ounces from Michigan copper ore, 5,964 ounces from Missouri lead-copper-cobalt-nickel-iron ore, and 2,437 ounces from Southern Illinois zinc-lead fluorspar and lead fluorspar ores.

Copper.—The bulk of the Central States output of copper comes from Michigan. Although a number of projects designed to augment production in Michigan were completed in 1943 and 1944, shortage of labor prevented full utilization of some of the productive capacity thus

obtained, and the State output was less than in 1943. Missouri production increased in 1944, as more copper was recovered as a by-product in smelting lead concentrates, and a substantial tonnage of copper concentrates was shipped from the new Madison mill, at Fredericktown, which treated lead-copper-cobalt-nickel-iron ore.

Lead.—The Central States produced 48 percent of the United States total mine output of lead in 1943 and about the same percentage in 1944. Production in Southeastern Missouri, which contributes most of the Central States output, decreased 5 percent from 1943; the output in the Tri-State district (Kansas, Southwestern Missouri, Oklahoma), also an important source of lead, decreased 19 percent. These two districts produced 98 percent of the Central States lead output in 1944; the rest came from Wisconsin, Illinois, Central Missouri, and Kentucky.

Zinc.—The 3-percent decrease in zinc production in the Central States in 1944 resulted largely from a 5-percent decline in output in the Tri-State district, which contributed 89 percent of the total in 1944 and 90 percent in 1943. A general review of mining and milling in this region is given in this chapter under Southwestern Missouri. The outputs in the Wisconsin-Northern Illinois and Kentucky-Southern Illinois districts were larger than in 1943. Other small zinc-producing districts in 1944 were Southeastern and Central Missouri and Northern Arkansas.

MINE PRODUCTION BY STATES AND REGIONS

Here production of silver, copper, lead, and zinc in the Central States in 1944, by States, in terms of recovered metals

State	Mines producing	Material sold or treated		Silver	
		Crude ore (short tons)	Old tailings (short tons)	Fine ounces	Value
MISSOURI	2	800			
KANSAS	13	1,165,044		2,437	\$1,733
OKLAHOMA	85	3,175,152	2,054,643		
ILLINOIS	11	17,945			
KENTUCKY	12	2,382,525	3,027,713	54,218	38,555
WISCONSIN	96	8,664,198	516,894	92,243	65,595
INDIANA	106	3,890,257	9,721,473		
ARIZONA	61	394,712	229,099		
1943	386	18,600,633	15,549,822	148,898	105,883
1944	407	19,025,311	13,628,453	161,917	115,141

State	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
MISSOURI					19	\$4,332	\$4,332
KANSAS			1,971	\$315,360	7,262	1,655,736	1,972,829
OKLAHOMA			9,394	1,503,040	63,703	14,524,284	16,027,324
ILLINOIS			170	27,200	341	77,748	104,948
KENTUCKY	84,842,000	\$11,453,670					11,492,225
WISCONSIN	6,604,000	891,540					37,257,143
INDIANA			174,683	27,949,280	36,626	8,350,728	23,081,412
ARIZONA			13,944	2,231,040	91,449	20,850,372	3,771,572
1943			1,415	226,400	15,549	3,545,172	93,711,785
1944	91,446,000	12,345,210	201,577	32,252,320	214,949	49,008,372	93,285,893
	96,208,000	12,507,040	217,060	32,559,000	222,707	48,104,712	

Includes lead-bearing material mined with fluorspar and from which some lead was recovered as a by-product of the mining and milling of the fluorspar.

Mine production of lead and zinc in the Central States in 1944, by regions

Region	Lead ¹		Zinc ²		Total value
	Short tons	Value	Short tons	Value	
Concentrates:					
Joplin or Tri-State	36,934	\$4,364,226	355,401	\$36,565,544	\$40,929,770
Southeastern Missouri	242,829	19,858,503	2,982	95,729	19,954,232
Upper Mississippi Valley ³	2,085	181,776	31,819	2,139,662	2,321,438
Kentucky-Southern Illinois	2,995	222,113	10,512	688,943	911,056
Central Missouri	450	61,697	224	16,756	78,453
Northern Arkansas			57	2,246	2,246
Total, 1943 ⁴	285,293	24,688,315	400,995	39,508,880	64,197,195
	308,455	24,436,475	417,528	40,100,180	64,536,655
Recoverable metal:					
Joplin or Tri-State	28,059	4,489,440	190,270	43,381,560	47,871,000
Southeastern Missouri	169,622	27,139,520	⁵ 1,429	325,812	27,465,332
Upper Mississippi Valley ³	1,508	241,280	17,242	3,931,176	4,172,456
Kentucky-Southern Illinois	2,048	327,680	5,910	1,347,480	1,675,160
Central Missouri	340	54,400	79	18,012	72,412
Northern Arkansas			19	4,332	4,332
Total, 1943 ⁴	201,577	32,252,320	214,949	49,008,372	81,260,692
	217,060	32,559,000	222,707	48,104,712	80,663,712

¹ Includes galena and small quantity of lead carbonate concentrates.² Includes sphalerite and small quantity of zinc carbonate and silicate concentrates.³ Region includes Iowa, Northern Illinois, and Wisconsin; no production in Iowa from 1918 to 1944, inclusive.⁴ Includes small quantity of zinc from Arbuckle Mountains region (Oklahoma).⁵ Includes 776 tons recovered from lead-smelter slags and residues.*Quantity and tenor of copper, lead, and zinc ores, old tailings, etc., produced in some ¹ Central States, 1942-44, by States*

State	1942		1943		1944	
	Ore, etc.	Metal content ²	Ore, etc.	Metal content ²	Ore, etc.	Metal content ²
	<i>Short tons</i>	<i>Percent</i>	<i>Short tons</i>	<i>Percent</i>	<i>Short tons</i>	<i>Percent</i>
Kansas	8,872,052	1.85	4,475,767	1.62	5,229,795	1.54
Michigan	4,362,640	1.05	4,403,594	1.06	5,410,238	.79
Missouri	9,298,758	2.63	9,440,151	2.36	9,181,092	2.43
Oklahoma	12,798,423	1.45	13,660,191	1.08	13,611,730	.85
Wisconsin	301,674	3.74	548,022	3.09	623,811	3.00
	30,633,547		32,527,725		34,056,666	

¹ Only small-scale intermittent mining done in Arkansas from 1918 to 1944; Kentucky and Illinois excluded because part of the metal output (lead and zinc) was a byproduct of fluorspar mining, and the quantity of metal-bearing material hoisted could not be determined.² The percentages represent metal content of the ore insofar as it is recovered in the concentrates. In Michigan the metal so recovered is copper; in Missouri, copper, lead, and zinc; and in Kansas, Oklahoma, and Wisconsin, lead and zinc. The relative proportions of the metals are shown in the third table of this chapter and in tables of tenor of ore given in sections devoted to the respective States.**MINING AND METALLURGIC INDUSTRY**

As payments under the premium-price plan were liberalized to permit utilization of very low grade ores, the chief problem confronting the mining industry in its efforts to maintain production rates was shortage of manpower. In general, the principal producing mines were kept in operation throughout the year, their rate of output depending upon the number of workers obtainable. Some of the mines not already fully mechanized added more labor-saving machinery, and a number of small mines reported initial use of mechanical loading and haulage equipment underground. A few mines that were being prepared for operation in 1943, mostly as war projects, began pro-

doing in 1944, but otherwise there was little expansion in mining activity. The Bureau of Mines, in cooperation with the Geological Survey, continued its investigation of sources of strategic and critical minerals; the work done on copper, lead, and zinc included exploratory drilling, geophysical surveys, scattered field examinations, and metallurgical tests on certain types of ores. Flotation was used in conjunction with gravity concentration in nearly all the mills, and flotation concentrates comprised 32 percent of the total copper concentrates (excluding copper-lead flotation concentrates from Missouri), 43 percent of the lead concentrates, and 60 percent of the zinc concentrates produced. The location of the smelters that treat the concentrates is given in the 1943 report of this series (Minerals Yearbook, 1943). The installation of waelz plants at some zinc smelters in recent years has resulted in recovery of additional metal from ores mined in the past and in reducing over-all current smelting losses. Old residues, current residues, and a small tonnage of crude carbonate ore treated in 6 waelz plants in the Central States in 1944 totaled 204,551 tons yielding 33,333 tons of oxide averaging 66 percent zinc and about 3 percent lead. Most of the oxide was smelted along with concentrates to produce metal.

REVIEW BY STATES

ARKANSAS

Production of zinc concentrates in Arkansas in 1944 totaled 57 tons of carbonate, compared with 235 tons of combined carbonate and sulfide in 1943. No lead was produced in the State in 1944 and only 1 ton in 1943. The Big Hurricane zinc carbonate open-pit mine in Searcy County was reopened in 1944 by the Grimmett Construction Co. Preliminary work included removal of overburden and building a 500-ton mill. The mill made several runs late in the year and produced a car of concentrates. The Gloria-Jack Pot (Moark) mill at Zinc in Boone County was reconditioned and treated about 200 tons of ore during test runs. The Advance Mining Co. erected a dry-concentration mill at the North Star mine near Harrison and made experimental runs on zinc sulfide ore. From November 1943 to May 1944 the Bureau of Mines did exploratory drilling totaling 2,729 feet on the Moark, Coon Hollow, Big Hurricane, and Spier properties.

ILLINOIS

Northern Illinois (see section on Wisconsin for output data).—The Ginte Mining Co. operated the Graham-Ginte mine and 400-ton jig mill north of Galena throughout 1944; the product, rougher jig concentrates, was sold to the Vinegar Hill mill at Cuba City, Wis. The Gray property south of Galena was acquired under lease by Tri-State Zinc, Inc., which from June through October sank a 197-foot shaft, cut stations, drove drifts into the ore, and built a 600-ton flotation mill. Mining and milling began in November. Exploratory drilling on the property was undertaken by the Bureau of Mines early in 1943, and, as a result of favorable showings and to encourage development of the property, drilling was continued to July 1944. The ore body was found to extend into the adjoining Bautsch property,

which was also drilled during 1944. Other Illinois properties drilled were the Lonergan at Menominee, the Skene at Elizabeth, and the Boevers near Galena.

Southern Illinois.—The Mahoning Mining Co. zinc-lead-fluorspar mines near Cave in Rock, Hardin County, continued to produce most of the output of zinc and lead from Southern Illinois. In 1944 the company operated the W. L. Davis-Deardorff, Anna L. Davis, East Green, and West Green shafts, which are 311, 165, 230, and 363 feet deep, respectively. The ore from all four shafts was trucked to the company flotation mill at Rosiclare for treatment. The products of the mill were fluorspar concentrates (mostly acid grade), zinc concentrates containing 62.60 percent zinc, and lead concentrates containing 69.76 percent lead. Besides ore from company mines, the mill treated some custom ore and bulk concentrates containing zinc, lead, and fluorspar, mostly from the Rosiclare Lead & Fluorspar Co. and Aluminum Ore Co. mines. Hillside Fluor Spar Mines and the Alco Lead Co. shipped byproduct lead concentrates. The Minerva Oil Co. newly developed zinc-fluorspar mine northeast of the Mahoning mines began producing in March 1944. The mine is equipped with a 200-ton flotation mill producing fluorspar concentrates and zinc concentrates; the zinc concentrates shipped averaged 62.37 percent zinc. The mine is opened by a 645-foot double-compartment shaft and drifts on the 640-foot level. The total output of lead concentrates in Southern Illinois in 1944 was 2,753 tons averaging 69.60 percent lead and about 7 ounces of silver to the ton, and that of zinc concentrates was 9,891 tons averaging 62.56 percent zinc. Production (in terms of recoverable metals) amounted to 1,878 tons of lead, 2,437 ounces of silver, and 5,569 tons of zinc, compared with 1,959 tons of lead, 2,153 ounces of silver, and 4,699 tons of zinc in 1943.

KANSAS

The Kansas zinc and lead mines are in the Tri-State (Joplin) mining region, embracing parts of Cherokee County, Kans., and Ottawa County, Okla., and about 12 counties in Southwestern Missouri. General details of the Tri-State mining industry are given in the following pages on Southwestern Missouri.

Production of zinc concentrates in Kansas increased 12 percent in 1944 from 1943, and lead concentrates decreased 1 percent. The Baxter Springs-Blue Mound-Treese area produced 104,750 tons of zinc concentrates and 11,511 tons of lead concentrates (89 and 95 percent, respectively, of the State total) in 1944. About 35 percent of the crude ore mined in the area was concentrated in the Central mill of the Eagle-Picher Mining & Smelting Co. at Cardin, Okla. Most of the ore was transported to the mill over the Northeast Oklahoma Railroad, which has spur tracks from the main line to the principal ore-hoisting shafts. Eagle-Picher mines in Kansas shipping to the mill were the Big John, Leopard, Parmenter, Sim C., Webber mines, Westside mines, Wilbur, and Youse-Slaughter. The Paxson, Stoskopf, and Swalley "D" mines and the Paxson mill were operated by Eagle-Picher as agent for the Metals Reserve Company.

Mine shipments of lead and zinc in Kansas, 1940-44

Year	Mines producing	Lead concentrates		Zinc concentrates		Metal content ¹			
		Short tons	Value	Short tons	Value	Lead		Zinc	
						Short tons	Value	Short tons	Value
1940	34	15,424	\$907,296	105,070	\$4,420,360	11,927	\$1,192,700	57,032	\$7,186,032
1941	58	18,888	1,264,147	131,406	6,595,808	14,538	1,657,332	71,403	10,710,450
1942	81	12,253	1,167,302	103,247	6,926,745	9,419	1,262,146	55,874	10,392,564
1943	82	12,243	1,457,764	105,656	10,567,578	9,213	1,381,950	56,944	12,299,904
1944	86	12,176	1,352,367	117,827	11,380,580	9,394	1,503,040	63,703	14,524,284

¹ In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the value of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Factor of lead and zinc ore and old tailings milled and concentrates produced in Kansas, 1943-44

	1943		1944	
	Crude ore	Old tailings	Crude ore	Old tailings
Total ore and old tailings milled.....short tons..	2,790,570	1,685,197	3,175,152	2,054,643
Total concentrates produced:				
Galena.....do.....	12,235	8	12,170	6
Sphalerite.....do.....	98,859	6,797	109,590	8,237
Ratio of concentrates to ore, etc.:				
Lead.....percent.....	0.44		0.38	
Zinc.....do.....	3.54	0.40	3.45	0.40
Metal content of ore, etc.:				
Lead.....do.....	.34		.30	
Zinc.....do.....	2.13	.23	2.08	.23
Average lead content of galena concentrates.....do.....	76.80	60.00	78.73	71.85
Average zinc content of sphalerite concentrates.....do.....	60.03	57.73	60.23	58.03
Average value per ton:				
Galena concentrates.....	\$119.09	\$88.75	\$111.07	\$104.33
Sphalerite concentrates.....	100.55	92.22	96.29	100.52

¹ Figures represent metal content of the crude ore (or "dirt") only insofar as it is recovered in the concentrates; data on tailing losses not available.

The St. Louis Smelting & Refining Co. mines served by the company Ballard central mill were large producers; they comprised the Ballard, Bailey, Clark, English "O", Keith, Shanks, Slaughter, Walter H., and Moore mines. The No. 4 mine in Oklahoma also shipped ore to the Ballard mill in December. The Smith and Swalley (Beck) mines and the MacArthur mine shipped ore to the Beck No. 3 mill at Baxter Springs. The Liza Jane (Lula Bell) shipped to the Farmington mill in Oklahoma. The Harris Mining Co. Robinson, Silver Fox, and Evans Wallower No. 24 mines, the Federal Muncie-Tar Creek-Semple group, and the Southern and Jarrett mines shipped to the Youngman mill. The Bilharz Mining Co. operated its mill and three shafts on the Bilharz-Brewster property. The Bendelari, Ebenstein (Bilwil), Guaranty No. 2 (Robob), Mark Twain (old Blue Mound), and Wright mines shipped ore to the Central mill, and the M. & H. (Lawrence-McNulty) shipped to the Mission mill (Okla.). The Dines Mining Co. operated the Hartley mine in Kansas and the Dines No. 3 in Oklahoma; the ore produced was treated in the company mill in Kansas, which also treated custom ore from the C. K. & E. (Stebbins)

and Robinson (Jarrett) mines. The Peru mine and mill, operated since October 12, 1940, by the Madison Mining Co., were closed in November 1944. The Wade mill handled company ore from the Wade-Hunter mine and custom ores from other small mines in Kansas and Oklahoma. The Worley (New Blue Mound) mill treated old tailings from Kansas and custom mine dirt from Oklahoma. The Barr Cleanup Co. ran a section of the old Webber mill on clean-up material. The Captain and Semple (Early Bird) tailing mills were run throughout 1944.

At Galena, the Eagle-Picher Illinois and Murphy mines and the Galena Mining Co. Southside mine shipped ore to the Central mill. The Mess Cave Mining Co. worked the Mess Cave-Windsor by open-pit methods, shipping the ore to custom mills. Tri-State Zinc, Inc., built a tailing mill on Short Creek and operated it from April to November. Other small-scale operators at Galena shipped considerable ore to custom mills. At Peacock, the Carson Mining & Milling Co. operated its tailing mill throughout the year. At Lawton, the Eastern Mining Co. shipped some ore from the Fletcher mine.

In the Kansas part of the Waco district, the St. Louis Smelting & Refining Co. operated the Acme, Barnsdall No. 1, and Grasselli mines and the Waco No. 9 mill. F. W. Evans Mines operated the Barnsdall No. 3 and O'Neill mines and the F. W. Evans mill. Both mills also handled company ore from other mines across the Stateline in Missouri. The Stotts City Mining Co. operated the J. M. and Oscar Bennett mines, shipping the ore to the No. 9 mill.

KENTUCKY

Mines in Kentucky, including fluorspar mines yielding zinc and lead as byproducts, produced 341 tons of recoverable zinc and 170 tons of lead in 1944, compared with 931 and 240 tons, respectively, in 1943. The Eagle-Picher Nunn zinc-lead mine near Marion, principal producer of zinc in 1943, was idle throughout 1944. The Twin Valley Mining Co. operated the old Gratz zinc-lead mine and 100-ton mill in Owen County on a small scale from January to November. In Livingston County, the Kentucky Fluor Spar Co. shipped byproduct lead concentrates to the Federal smelter at Alton, Ill., and the Eagle Fluor Spar Co. shipped zinc-lead ore to the Eagle-Picher Central mill at Cardin, Okla. In Crittenden County the United States Coal & Coke Co. shipped byproduct zinc and lead concentrates, and the National Fluorspar Co. shipped byproduct lead concentrates. The Corod Minerals Corporation 150-ton custom flotation mill at Marion, built to treat zinc- and lead-bearing fluorspar, operated a few weeks early in 1944; the output included no lead concentrates and less than a car of zinc concentrates. Some ore containing zinc, lead, and fluorspar was shipped from Kentucky mines to the Mahoning mill at Rosiclare, Ill.

MICHIGAN

Production of copper from mine rock in Michigan increased 1 percent in 1944 from 1943 but that from reclamation plants decreased 31 percent—a 9-percent drop in the State total. The sharp decline in

Output from old tailings had been anticipated, as the reserves of high-grade conglomerate tailings (an important source of copper during the past 30 years) were nearly exhausted by the end of 1943, and most of the remaining sands that could be reclaimed were low-grade argillaceous tailings. The anticipated larger increase in production from mine rock did not materialize owing to shortage of labor in the mines. The ceiling price of copper remained at 12 cents a pound throughout the year, and the Government continued to pay special or premium prices to individual mines. The average value per pound of the copper reported by the mine operators (including increment from special prices and premiums for overquota production) was 14 cents, compared with 16.19 cents in 1943 and 12.83 cents in 1942. The rock treated in 1944 totaled 2,382,525 tons and reclaimed tailings 3,027,713 tons, compared with 2,311,669 and 2,091,925 tons, respectively, in 1943. The tailings yielding 25 percent of the copper in 1944 and 32 percent in 1943.

The concentrate ("mineral") produced at mills in Michigan in 1944 and the mass copper shipped direct from the mines were smelted at plants of the Calumet and Hecla Consolidated Copper Co. at Hubbell and the Copper Range Co at Houghton. Some of the copper bullion was cast into anodes and shipped to the electrolytic refinery at Laurel, N. Y., where silver was recovered. Some native silver was recovered in mill jigs and by hand-picking from tables; that alloyed with copper was treated by ammonia leaching to remove the copper before shipment to the mint. Considerable silver not reported as such production is retained in copper bullion used for making commutators in electric-motor armatures, engravers' plate, trolley wire, and other articles. The quantity of silver in this bullion ranges from 15 to 26 ounces to the ton. Of this quantity, about 10 ounces is derived directly from the ore and the rest is purchased from dealers and added to the bullion. Bullion containing the added silver brings a premium of one-half cent a pound. The silver is said to raise annealing temperatures, prevent brittleness, facilitate soldering, and increase hardness and conductivity.

Mine production of silver and copper in Michigan, 1940-44¹

Year	Silver (fine ounces)	Copper			Concentrate ("mineral")		Crude ore and sands (short tons)
		Pounds	Yield		Pounds	Yield (percent copper)	
			Pounds per ton of crude ore and sands	Percent			
1940	88,657	90,396,000	20.4	1.02	138,451,495	65.3	4,438,219
1941	60,796	92,880,000	21.7	1.08	141,100,268	65.8	4,282,448
1942	61,674	91,358,000	20.9	1.05	141,372,582	64.6	4,362,640
1943	48,479	93,528,000	21.2	1.06	143,142,155	65.3	4,403,594
1944	54,218	84,842,000	15.7	.78	129,646,181	65.4	5,410,238

¹Figures based upon actual recovery of copper from "mineral" smelted and estimated recovery from "crude" not smelted during year.

Value of silver and copper produced in Michigan mines, 1940-44

Year	Silver	Copper		Total	Year	Silver	Copper		Total
		Total	Per ton of crude ore and sands				Total	Per ton of crude ore and sands	
1940....	\$63,045	\$10,214,748	\$2.30	\$10,277,793	1943....	\$34,474	\$12,188,640	\$2.76	\$12,193,114
1941....	43,233	10,959,840	2.56	11,003,073	1944....	38,555	11,453,670	2.12	11,492,225
1942....	43,857	11,054,318	2.53	11,098,175					

¹ Value of copper calculated at average weighted price (including Government bonuses) for all domestic copper sold (see first table of this chapter, footnote 3). If calculated at actual prices paid to Michigan operators, the value of the copper was—1942: \$11,722,792, or \$2.69 to the ton of crude ore and sands; 1943: \$15,139,831, or \$3.44 to the ton; 1944: \$14,033,131, or \$2.59 to the ton.

The Calumet and Hecla Consolidated Copper Co. operated the Ahmeek stamp mill, the Lake Linden and Tamarack reclamation plants, the Hubbell smelter, and the Ahmeek, Central, Douglass, Iroquois, North Kearsarge, Peninsula, Allouez No. 3, and Centennial mines. All the mines except the last two were also in operation in 1943; the Allouez No. 3 was reopened in January 1944 and the Centennial in March. Reconditioning of the idle Calumet mill, begun in 1943 to provide additional milling capacity, was suspended owing to an acute labor shortage that prevented expansion of crude ore output to the level contemplated. The following data are extracted from the annual company report to stockholders:

Because of a gradually increasing shortage of labor, underground production fell off materially during the latter part of the year. This factor, coupled with a declining grade of ore and advancing supply and labor costs, resulted in a general increase in operating expense. During 1944 the company purchased two large areas of land and other smaller ones on the copper formation in Michigan. One area embraced the old Mass-Michigan and Flint Steel properties in Ontonagon County, where previous exploration under an option to purchase had indicated the presence of a body of low-grade ore; the purchase price was \$40,000. Another area purchased comprised the Keweenaw Copper Co. property in Keweenaw County adjacent to lands already owned by Calumet and Hecla. The lands and rights in lands aggregate approximately 35,544 acres, all in the known mineral belt. Payment for the lands and other assets acquired was made by issuance to the Keweenaw Copper Co. of 62,768 shares of the authorized but unissued capital stock of Calumet and Hecla. A smaller area acquired included the lands of the old Torch Lake Mining Co. just south of Calumet, purchased for \$10,000. The Ahmeek mill stamped the rock from all operating mines and explorations, amounting to 1,494,417 tons. The Lake Linden reclamation plant operated on conglomerate tailings from May to November and on adjacent amygdaloid sands the rest of the year. At the Tamarack reclamation plant the conglomerate tailings deposit was depleted in August. Production up to that time had totaled 97,894,087 pounds of copper. With the exhaustion of the conglomerate deposit the leaching process was discontinued, and the regrinding and flotation equipment was remodeled for more efficient treatment of the marginal-grade amygdaloid tailings. Reconstruction of the discontinued leaching-plant machinery is now in progress to adapt it to the production of copper oxide from secondary copper products.

The Copper Range Co. operated the Champion and Globe mines, Freda mill, and Houghton smelter throughout 1944 and the reclamation plant at the Freda mill about 6 months. The smelter treated company concentrates as well as custom concentrates and mass copper from the Isle Royale and Quincy mines. Data extracted from the annual company report to stockholders follow. Production from the two mines totaled 13,989,318 pounds of refined copper,

compared with 16,886,013 pounds in 1943. The decrease in production was due mainly to loss of men to the armed forces and to the drop in average grade of ore mined. The reclamation plant produced 554,909 pounds of refined copper, compared with 571,674 pounds in 1943. Exploration was carried on at a somewhat lower rate than in 1943 and was confined principally to lodes east and west of the main lode, which appears near exhaustion. Development of the explored areas proceeded at an increased rate and resulted in a substantial increase in ore reserves. Diamond drilling at the White Pine property was continued. The results of this work and other studies have been sufficiently favorable to warrant further and more detailed tests and investigations toward formulating plans for development.

The Isle Royale Copper Co. operated the Isle Royale mine and mill throughout 1944. Ore treated totaled 311,072 tons yielding 1,795,176 pounds of fine copper, compared with 308,446 tons yielding 6,279,771 pounds in 1943. According to the annual company report to stockholders, operations were carried on under adverse conditions. The most serious set-back was the loss to the armed forces of virtually all employees in the 19 to 25 age group. A further increase in the rate of absenteeism, especially among underground workers, made it necessary to concentrate on production and curtail exploratory work. Only two stamp heads were operated in the mill, and for the most part milling was on the basis of five days a week. Attention was paid to the problem of reworking accumulated stamp sands. Some experimental work was done during the year, but the results were inconclusive; additional work will be done in 1945.

The Quincy Mining Co. ran its Quincy mine and mill and new 4,000-ton tailings reclamation plant throughout 1944. Output from the mine increased slightly over 1943. The reclamation plant, which began operating on Torch Lake November 1, 1943, performed well within original estimates as to sand-treatment capacity, efficiency in copper recovery, and quantity of copper produced.

MISSOURI

In 1944 Missouri again maintained, by a wide margin, the rank it has held for 37 years as the chief lead-producing State; it ranked ninth in zinc production. Silver and copper continued to be recovered as byproducts in smelting lead concentrates from Southeastern Missouri, and considerable copper and a little silver were derived from lead-copper-cobalt-nickel-iron ore. Silver recovered totaled 92,243 ounces and copper 3,302 short tons, compared with 111,285 ounces and 1,340 tons, respectively, in 1943. In the sale of the lead concentrates, no value is attached to the silver and copper, as the quantity recovered per ton of concentrates is very small. The lead output of the State comes largely from the Southeastern region and the zinc mostly from Southwestern Missouri. The Central district of Missouri produced some lead and zinc annually from 1940 to 1944, inclusive; the figures are included with those of Southeastern Missouri in the table that follows.

Mine production of lead and zinc in Southeastern and Central Missouri, 1940-44

Year	Lead concentrates (galena)		Zinc concentrates ¹		Metal content ²			
	Short tons	Value ³	Short tons	Value	Lead		Zinc	
					Short tons	Value	Short tons	Value
1940.....	232, 871	\$14, 269, 600	815	\$20, 000	169, 908	\$16, 990, 800	233	\$29, 358
1941.....	228, 572	15, 404, 226	5, 192	73, 202	164, 388	18, 740, 232	1, 100	165, 000
1942.....	277, 255	19, 426, 540	1, 739	41, 913	197, 432	26, 455, 888	842	156, 612
1943.....	257, 305	18, 490, 413	2, 284	99, 710	179, 134	26, 870, 100	923	199, 368
1944.....	243, 279	19, 920, 200	3, 206	112, 485	166, 962	27, 193, 920	1, 508	343, 824

¹ Includes zinc-lead carbonate concentrates.

² In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

³ Values given are to a certain extent arbitrary, as part of the lead concentrates are smelted by the producer.

• Includes 450 tons recovered from lead-smelter slags.

• Includes 360 tons recovered from lead-smelter slags.

• Includes 776 tons recovered from lead-smelter slags and byproduct matte from lead smelting.

Mine production of lead and zinc in Southwestern Missouri, 1940-44

Year	Lead concentrates				Zinc concentrates				Metal content ¹			
	Galena		Carbonate		Sphalerite		Silicate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	2, 818	\$158, 556	57	\$2, 446	22, 917	\$959, 356	807	\$10, 965	2, 144	\$214, 400	12, 470	\$1, 571, 220
1941.....	2, 084	125, 730	90	4, 379	38, 513	1, 923, 472	1, 277	14, 355	1, 521	173, 394	20, 832	3, 124, 800
1942.....	2, 790	303, 331	20	864	66, 881	4, 791, 020	1, 510	23, 940	2, 116	283, 544	35, 552	6, 612, 672
1943.....	7, 679	908, 591	-----	-----	56, 357	5, 724, 079	1, 037	51, 261	5, 776	866, 400	29, 490	6, 369, 840
1944.....	6, 294	752, 796	9	855	64, 651	6, 898, 980	2, 453	218, 017	4, 721	755, 360	35, 118	8, 006, 904

¹ In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead ore and concentrates in Southeastern Missouri disseminated-lead district, 1940-44

	1940	1941	1942	1943	1944
Total lead ore ¹ short tons.....	5, 837, 400	5, 737, 230	7, 107, 191	6, 831, 377	6, 535, 874
Galena concentrates in ore.....percent.....	3.99	3.98	3.90	3.76	3.72
Zinc content of ore.....do.....	(²)	(²)	(²)	(²)	(²)
Average lead content of galena concentrates.....percent.....	74.45	73.31	72.65	70.99	71.02
Average value per ton of galena concentrates.....	\$61.28	\$67.39	\$70.04	\$71.79	\$81.78

¹ Includes lead-copper ore.

² Figures not available.

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Southwestern Missouri, 1943-44

	1943		1944	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled..... short tons.....	1,861,044	704,125	2,052,979	516,894
Total concentrates produced:				
Lead..... do.....	7,658	21	6,299	4
Zinc..... do.....	51,149	6,245	63,033	4,071
Ratio of concentrates to ore, etc.:				
Lead..... percent.....	0.41	0.003	0.31	0.001
Zinc..... do.....	2.75	.89	3.07	.79
Average content of ores, etc.:				
Lead..... do.....	.32	.002	.23	.....
Zinc..... do.....	1.58	.49	1.79	.44
Average lead content of galena concentrates..... do.....	76.8	66.7	76.44	62.00
Average lead content of lead carbonate..... do.....	.....	.....	64.00	.....
Average zinc content of sphalerite concentrates..... do.....	57.83	55.20	58.97	56.50
Average zinc content of silicates and carbonates..... do.....	35.29	.....	42.11	.....
Average value per ton:				
Galena concentrates.....	\$118.40	\$91.29	\$119.61	\$109.00
Lead carbonate concentrates.....	.....	.....	95.00	.....
Sphalerite concentrates.....	103.85	83.27	108.37	81.99
Zinc silicates and carbonates.....	49.43	.....	88.88	.....

Figures represent metal content of the crude ore (or "dirt") only insofar as it is recovered in the concentrates; data on tailing losses not available.

Southeastern and Central Missouri.—Production of recoverable lead in Southeastern Missouri was 169,622 tons in 1944, compared with 179,012 tons in 1943.

The mines of the St. Joseph Lead Co. in St. Francois County continued to contribute the bulk of the output. The groups operated in 1944 were the Bonne Terre, with 3 operating shafts; Desloge, 2 shafts; Federal, 7 shafts; and Leadwood, 1 shaft. The depth of the shafts ranged from 181 to 755 feet and averaged 424 feet. Each group has a central ore-hoisting shaft and a mill; the other shafts are used for men, supplies, and poor rock. The mills together have a total daily capacity of 21,400 tons. Mining operations were hampered by withdrawal of men for military service and for other war industries. Many of the men had been trained under the company system of employing local young men and training them for key jobs, and their departure caused a serious loss in over-all labor efficiency. The continued high rate of ore extraction required much exploration and development to maintain ore reserves. Diamond drilling at the four groups of mines totaled 3,408,574 feet in 1944 and drifting and raising 68,823 feet. According to the company annual report to stockholders, development in 1944 was most satisfactory in proving additional ore reserves. At the request of Government war agencies, late in the year the company curtailed development and continued to operate its mines beyond their economic limits to help alleviate the lead shortage. Some of the concentrates from the mills were shipped to the company Herculeanum smelter and some to the Federal smelter at Alton, Ill. The concentrates contain a little silver, copper, and zinc, part of which was recovered in smelter byproducts. Additional zinc was recovered as metal from slag treated in the electrothermic zinc plant at the Herculeanum smelter.

In Madison County the Mine La Motte mine and 1,500-ton mill of the Mine La Motte Corporation (50-percent owned by the St. Joseph Lead Co.) were run continuously. Development during the

year totaled 4,192 feet of drifts and raises and 60,636 feet of churn drilling. The Fredericktown Lead Co. operated its 400-ton mill and the Catherine and Fleming mines. Part of the ore mined came from the new 73-foot shaft sunk in 1944 on a previously undeveloped part of the Catherine property. In January the Park City Consolidated Mines Co. began shipping lead concentrates from its 500-ton flotation mill at the company newly developed Ruth mine; the mine and mill were operated throughout 1944. The mine is opened by a 370-foot shaft and about 1,625 feet of drifts. At the Madison mine group of the St. Louis Smelting & Refining Co. (comprising the leased Missouri Cobalt property and other company-owned properties) preliminary development was completed early in 1944, and the newly installed 600-ton flotation mill began operating in February. The mine is worked through 3 shafts averaging about 425 feet in depth. The ore contains lead, copper, cobalt, nickel, and iron; the products of the mill were copper-lead, lead-copper, cobalt-nickel, and iron concentrates. The copper-lead concentrates were shipped to smelters at Garfield, Utah, and El Paso, Tex. The lead-copper concentrates were shipped to the Herculaneum (Mo.) smelter, and the iron concentrates were discharged to pond storage. At first the cobalt-nickel concentrates were treated in a reverberatory furnace and roaster adjacent to the mill and then shipped to the Ferro Enamel Corporation, Cleveland, Ohio, for final treatment; later, preliminary treatment involved roasting only. Of the 242,829 tons of lead concentrates made in 1944 in Southeastern Missouri, about 112,469 tons were flotation concentrates.

At Valles Mines, Jefferson County, the DeSoto Lead & Zinc Co. 200-ton mill operated on zinc-lead-iron carbonate ore from dumps on the Valle Mining Co. properties; the concentrates were shipped to the Ozark pigment plant at Coffeyville, Kans. About 135 tons of galena were shipped from barite workings in Southeastern Missouri.

In Central Missouri the Wemhaner Mining Corporation mined zinc, lead, and coal from the open-pit mine on the Monarch Coal & Mineral Co. land in Moniteau County. The ore was treated in a 100-ton jig mill. The D. F. & H. Mining Co. operated the Lowery lead-barite open-pit mine and 100-ton mill near Enon from January to August, when the deposit was reported worked out.

Southwestern Missouri.—The following table, the first five paragraphs, and the graphs under this heading pertain to the Tri-State mining industry as a whole; the remaining text reviews mining and milling in Southwestern Missouri only.

The monthly output rate for Tri-State zinc concentrates derived from crude ore in 1944 trended sharply downward after June and averaged only 20,870 tons in the last quarter of the year, compared with 29,568 tons in the first quarter; the rate for concentrates from old tailings remained fairly constant from January to November but dropped in December. About 52 mills were operating in the region in December 1944, of which 16 were tailing mills, compared with 58 in December 1943, including 17 tailing mills. Stocks of concentrates in the mill bins were small at the end of 1944; the zinc concentrates accumulated in the first part of the year at the Paxson mill—a Metals Reserve Company project—were shipped to the Henryetta (Okla.) smelter.

Production of lead and zinc concentrates in the Tri-State district (Kansas, Oklahoma, and Southwestern Missouri), 1940-44

FROM CRUDE ORE

Year	Ore, etc., milled (short tons)	Concentrates pro- duced (short tons)		Concentrate recovery (percent)		Average assay of concentrates (percent)		Average value per ton of concentrates	
		Lead	Zinc	Lead	Zinc	Lead	Zinc	Lead	Zinc
1940	6,536,700	45,493	355,193	0.70	5.43	78.37	60.20	\$59.20	\$42.35
1941	8,091,579	53,329	404,367	.66	5.00	78.27	60.36	67.15	50.33
1942	8,587,337	44,397	378,751	.52	4.41	78.35	59.86	99.55	68.00
1943	9,430,812	45,941	319,370	.49	3.39	76.68	59.46	120.77	101.01
1944	9,118,388	36,544	301,854	.40	3.31	77.79	59.72	118.65	103.72

FROM OLD TAILINGS REMILLED

1940	8,482,000	719	74,585	0.01	0.88	52.29	59.63	\$44.06	\$10.49
1941	10,515,611	361	74,036	.003	.70	51.52	58.80	44.38	48.71
1942	10,239,121	460	65,096	.004	.64	55.87	57.84	80.06	79.10
1943	11,270,106	404	56,857	.004	.50	50.25	57.88	66.42	93.78
1944	12,293,010	390	53,547	.003	.44	51.79	58.26	72.07	98.18

DISTRICT TOTAL

1940	15,018,700	46,212	429,778	0.31	2.86	77.96	60.10	\$58.96	\$42.03
1941	18,610,190	53,690	478,403	.29	2.57	78.09	60.12	67.00	50.08
1942	18,826,458	44,857	443,847	.24	2.36	78.12	59.57	99.35	69.63
1943	20,700,918	46,345	376,236	.22	1.82	76.45	59.22	120.30	99.92
1944	21,411,398	36,934	355,401	.17	1.66	77.52	59.50	118.16	102.80

The method of marketing the mine output of the Tri-State or Joplin region is explained in the reports of this series for 1940 and 1941. The total value given for all the concentrates is based upon actual receipts by the sellers, including premiums paid by the Government since February 1, 1942, for overquota mine production. The quoted weekly market price for zinc concentrates at Joplin remained at \$55.28 a ton throughout 1944; the quoted metal contract price on galena continued at \$76.54 until March 18, when it dropped slightly to \$76.01, and it remained at that level the rest of the year. Government premium payments for 60-percent zinc concentrates continued at \$29.70 a ton for assigned production under the A-level quota, \$59.40 for B-level, and \$89.10 for C-level; for 80-percent lead concentrates the payments were \$41.80 for A-level and \$83.60 for B-level.

The B- and C-level premiums enabled many marginal and sub-marginal mines to operate throughout 1944, but in general neither these mines nor the higher-grade mines could maintain capacity output owing to shortage of labor and difficulty in obtaining some materials, especially heavy-duty tires for ore trucks. Keeping the low-grade mines open is an important factor in the operation of some of the higher-grade mines in areas such as the Picher field, where underground workings of many mines are connected and pumping costs are too high to be borne by a few mines. Also, low-grade ore can be treated economically by utilizing excess capacity of active mills. Mechanized mining offers interesting possibilities for extending the productive life of the district. Mechanized open-pit mining at Oronogo, Webb City, and Galena has proved feasible for working certain types of deposits, and another large-scale open-pit operation near Baxter Springs was undertaken by F. W. Evans Mines early in 1945.

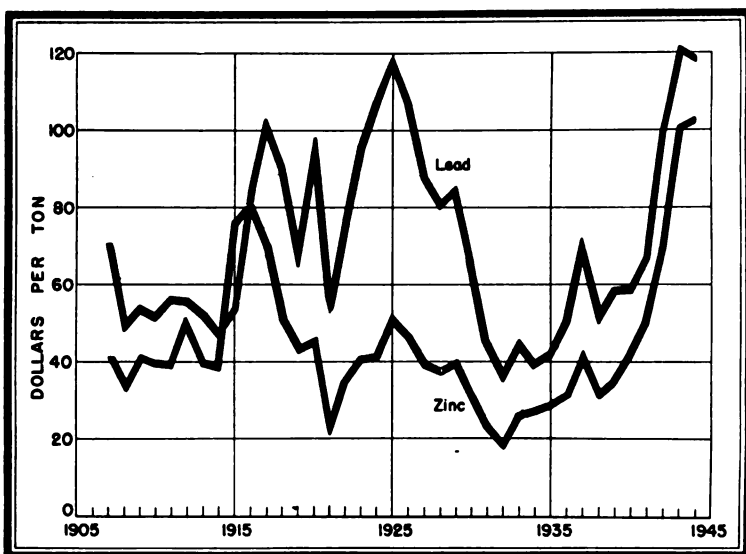


FIGURE 1.—Average prices received by sellers per ton of concentrates in the Tri-State district, 1907-44.

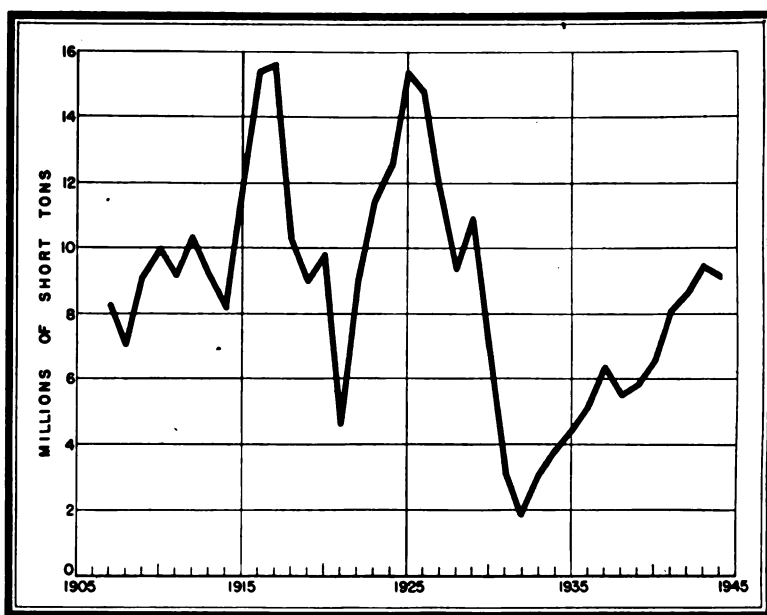


FIGURE 2.—Quantity of crude ore milled in the Tri-State district, 1907-44.

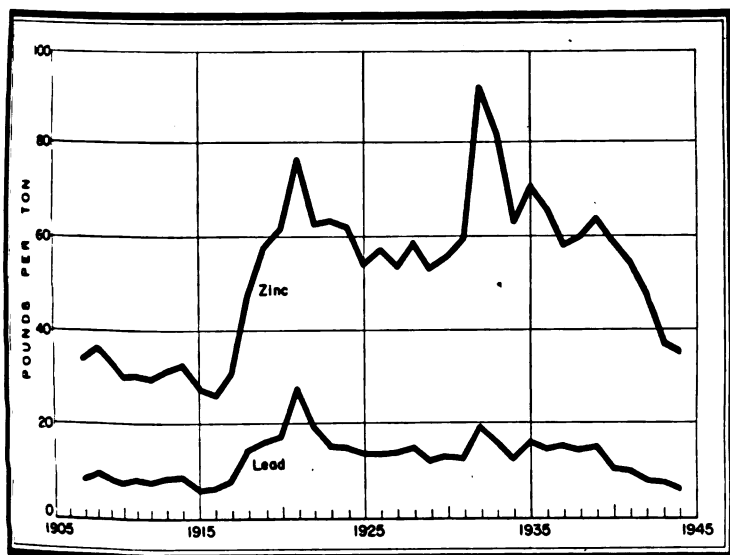


FIGURE 3.—Metal recovered per ton of crude ore (rock) milled in the Tri-State district, 1907-44.

Activity in prospect drilling decreased somewhat from 1943. Work was completed in January 1944 on the exploratory project of Brown & Root as agent for the Metals Reserve Company in the Webb City field, where 45,300 feet of churn drilling proved the existence of large low-grade deposits, which if needed could be utilized for war production at premium prices. The Bureau of Mines did churn drilling in the Stotts City, Wentworth, Joplin, Galena, Baxter Springs, Ozark, and Melrose areas and made scattered field examinations. The Reconstruction Finance Corporation continued its mine-loan office at Joplin.

In Southwestern Missouri production of zinc concentrates increased 17 percent in 1944 over 1943 and that of lead concentrates decreased 18 percent. The Oronogo Circle open-pit mine of the Oronogo Mutual Mining Co. was again the largest individual producer of zinc concentrates in Missouri. Part of the ore was treated in the Eagle-Picher American mill on the property, and part was shipped to the Eagle-Picher Central and Bird Dog mills in Oklahoma. The pit is 230 feet deep. Ore from a shaft on the property operated by Fenix & Sons was shipped to the Central mill. Other large Missouri producers were Kansas Explorations, Inc., operating the Snapp and Buckingham-Gibson mines and the Snapp mill near Oronogo and the Jasper mine and mill near Joplin; the Federal Mining & Smelting Co., operating the Granby-American and Davis groups of mines, the Granby-American mill, and the Duenweg mine and mill; the American Zinc, Lead & Smelting Co., operating the Hunter mine and mill at Aurora throughout the year and the Henckel and Smith mines near Duenweg from January 1 to October 6; the St. Louis Smelting & Refining Co. Waco mines and the F. W. Evans Waco and Smithfield mines (ore treated in company mills in Kansas); Cooley Bros., operating the Sucker Flat open-pit mine and washing-concentrating plant at Webb City (closed

in July); and the Missouri Mining Co. tailing mill at Chitwood. The Eagle-Picher Navy Bean mill near Wentworth and the mines served by it were closed in January 1944.

Other producing mines equipped with mills were the Fenix & Martin La Tosca at Oronogo, the Capital at Stotts City, the Northside near Joplin, and the Playter (Reynolds group) at Waco. The Playter mill also treated custom ores, mostly from the Anderson (K. C. B.) property near Carl Junction, the Pleasant Valley-Southside near Carthage, the Lucky Tiger at Neck City, and the Little Pat in Joplin. The St. Louis Mining & Milling Co. custom mill at Thoms Station treated ore from the Pearl, Big Tom, and Coble mines near Thoms Station; the Richey-Thomas at Smithfield; the O'Jack near Joplin; the Sucker Flat (Cooley Bros.) at Webb City; and other small producers. Part of the ore from the O'Jack was milled at the Southside mill (operated by the C. & O. Mining Co. after September), and part of that from the Richey-Thomas was milled in the Lucky Jack mill near Carl Junction. The Wentworth Mining & Milling Co. ran the Kline mine and mill at Wentworth from May to September. The Sciota mill at Webb City treated coarse rock reject from the Cooley plant during January and February and tailings from the Gaunt Mining & Milling Co. lease during August, September, and October. Small tailing mills at Webb City, Neck City, and Granby produced some concentrates. The Monark mine at Ozark made a small output early in the year but was idle after May 9.

Most of the carbonate shipped from Southwestern Missouri in 1944 came from the Southwest Mining Co. mine at Stark City, equipped with a 250-ton mill. Some of the concentrates were shipped to the Athletic smelter at Fort Smith, Ark., and some to the E. I. du Pont de Nemours smelter at Meadowbrook, W. Va. Three cars of carbonate were shipped from Granby to the smelter at Meadowbrook, and 22 cars of low-grade carbonate were shipped from the Alice mine near West Plains to a waelz plant at La Salle, Ill.

OKLAHOMA

Mining and milling in the Tri-State region—which includes Northeastern Oklahoma—are discussed in the preceding pages on Southwestern Missouri. The Oklahoma area produced 48 percent of the total Tri-State output of zinc and 50 percent of the lead in 1944, compared with 57 percent of both zinc and lead in 1943. Production of recoverable zinc decreased 20 percent from 1943 and lead 29 percent. From 1918, when the Oklahoma output first surpassed that of Missouri, through 1944 Oklahoma produced 65 percent of the district total output of concentrates, and the crude ore extracted averaged 5,020,669 tons annually. This heavy drain upon ore reserves, with little recent expansion of the productive area, is reflected in the declining output of the past three years; however, the maximum potential output possible under prevailing prices (including the Government bonus) was not attained owing to labor shortage.

Mine shipments of lead and zinc in Oklahoma, 1940-44

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content ¹			
	Short tons	Value	Short tons	Value	Lead		Zinc	
					Short tons	Value	Short tons	Value
1940	27,913	\$1,656,497	300,984	\$12,672,186	21,240	\$2,124,000	162,935	\$20,529,810
1941	32,628	2,202,876	307,207	15,427,235	25,021	2,852,394	166,602	24,990,300
1942	29,794	2,985,285	272,209	19,163,622	22,806	3,056,004	146,510	27,250,860
1943	26,423	3,208,885	213,195	21,251,796	19,733	2,959,950	114,085	24,642,360
1944	18,455	2,258,188	170,470	18,067,967	13,944	2,231,040	91,449	20,850,372

¹ Calculating metal content of the ores from assays allowance has been made for smelting losses of both metal and base. In comparing the values of ore and metal it should be borne in mind that the value given for ore is that actually received by the producer, whereas the value of the lead and zinc is calculated at the average price for all grades.

² Includes 38 tons of zinc carbonate averaging 31.03 percent zinc.

Tonnage of lead and zinc ore, old tailings, and slimes milled and concentrates produced in Oklahoma, 1943-44

	1943		1944	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Crude ore, etc., milled.....short tons.....	4,779,407	8,880,784	3,890,257	9,721,473
Concentrates produced:				
Galena.....do.....	26,048	375	18,075	380
Sphalerite.....do.....	169,380	43,815	129,231	41,239
Lead concentrates to ore, etc.:.....percent.....	0.55	0.004	0.46	0.004
Zinc.....do.....	3.54	.49	3.32	.42
Metal content of ore, etc.: ¹				
Lead.....do.....	.42	.002	.36	.002
Zinc.....do.....	2.12	.29	1.99	.25
Crude lead content of galena concentrates.....do.....	76.59	49.07	77.64	51.58
Crude zinc content of zinc concentrates.....do.....	59.76	58.28	59.97	58.47
Average value per ton:				
Galena concentrates.....	\$122.26	\$64.55	\$123.44	\$71.17
Zinc concentrates.....	100.76	95.51	108.12	99.30

¹ Includes 58 tons of carbonate averaging 31.03 percent zinc.

² Figures represent metal content of the crude ore (or "dirt") only insofar as it is recovered in the concentrates, data on tailing losses not available.

The Central mill of the Eagle-Picher Mining & Smelting Co. at Cardin is the largest zinc-lead ore-reduction plant in the United States; it has a capacity of over 14,000 tons daily and is equipped with differential-density (sink-and-float) preliminary-concentration units, which furnish an enriched product for treatment by jigging and flotation. Improvements made in the mill in 1944 included equipment for using magnetic ferrosilicon to replace galena to maintain the high density of the heavy medium in the preliminary concentration units, and a gas-fired drying unit for lowering the moisture content of the zinc flotation concentrates. Crude ore treated during the year totaled 3,433,670 tons, of which 2,213,214 tons (64 percent) came from Oklahoma mines, compared with 3,762,266 tons in 1943, of which 2,662,101 tons (71 percent) came from Oklahoma. Eagle-Picher mines in Oklahoma shipping to the mill were: Blue Goose mines, Buffalo, Crystal-Central, Goodeagle mines, Gordon No. 2, Grace Walker mines, Hum-bah-wat-tah mines, John Beaver No. 2, Little Greenback, Mehunka, Netta, See Sah, Slim Jim-Vantage, Stanley, and Wesah

Greenback; other large Oklahoma shippers to the mill were: Davis Big Chief Mining Co. (Skelton, Imbeau, Lucky Bill), Federal Mining & Smelting Co. (Lucky Syndicate-Howe, Lucky Bill, Gordon), M. & M. Mining Co. (Crawfish, Piokee, La Salle, White, Swift), F. W. Evans (Shorthorn, Craig), Mahutska Mining Co. (Acme-Blackhawk, Cortez-Childress), Carpenter Mining Co. (New York, Oko), Bluebird Mining Co., and W. M. & W. Mining Co. (Velie). The Eagle-Picher 2,400-ton Bird Dog mill operated from January to May on ore from the Oronogo Circle mine in Missouri and company mines at Galena, Kans.

Other large producing mines equipped with mills were: Evans-Wallower No. 7, Scott (Jane E.), Kansas Explorations (Ritz), Lawyers Lead & Zinc Co. (mine rock and old tailings), Lula Bell (Farmington), Rialto Mining Corporation, Weidman Mining Co. (Woodchuck, Townsite), and United Zinc Smelting Corporation (Royal group). The Royal mill also handled custom ore from the Dixie R. mine and company ore from the newly developed Park Walton mine 8 miles west of Picher. Development at the Park Walton during the year included a second shaft 349 feet deep and 475 feet of drifts. Work on constructing a mill began in January 1945. The M. & W. Mining Co. Brewster-Huttig and Ninety-Six mines and the Dobson No. 4 and Pelican shipped ore to the Beck No. 1 mill. Cameron & Henderson operated the Romo mill on ore from company mines and custom ore from the Craig (Keeton) lease. The Mission mill handled some of the ore from the Craig lease and other custom ore, mostly from the Graham-Houston, Lotson, and Montreal mines. The St. Louis No. 4 mill treated crude ore and old tailings from the No. 4 property. The Baird, Mary C., and Ravelin (Skelton property) mines shipped ore to the Worley mill in Kansas, and the Dines No. 3 shipped to the Dines mill, also in Kansas.

All the large Oklahoma tailing mills that were active in 1943 continued running throughout 1944; they comprised the Atlas, Big Chief, Britt & Britt, C. G. & C., Cardin Nos. 2 and 3, Evans-Wallower No. 4 (tailings and some mine rock), Semple (Martin), Tri-State Zinc Ottawa and Sooner, and Western. The DeMier-Smith mill at Commerce was operated a short time in 1944 but was destroyed by fire September 4.

The Davis zinc district, Murray County, from which a little ore was shipped in 1943, produced none in 1944.

WISCONSIN

The Wisconsin zinc and lead district is in the Upper Mississippi Valley region, embracing parts of Grant, Iowa, and Lafayette Counties, Wis., Joe Daviess County, Ill., and Clayton and Dubuque Counties, Iowa. The Iowa part has had no output since 1917, and the only activity reported there in 1944 was exploratory drilling on two properties by the Bureau of Mines. In Wisconsin and Illinois, activity was stimulated by the war demand for metals and Government premium prices paid for overquota production. In 1944 the total output of finished (60-percent) zinc concentrates was 31,819 tons and lead concentrates 2,085 tons, compared with 28,768 and 1,430 tons, respectively, in 1943. The principal producer of finished concentrates was the Vinegar Hill Zinc Co., which operated its custom

near Cuba City on crude ore and zinc-iron-lead rougher jig concentrates purchased from operators throughout the active areas. The finished zinc and lead concentrates were shipped to smelters in Illinois, and the iron concentrates went direct to the company sulfuric acid plant adjoining the mill. Besides the crude ore treated in 1944, the company bought 29,345 tons for the Metals Reserve Company stock pile; this ore is not included in the production for 1944 shown in the tables of this chapter but will be credited to that for the year in which the ore is reduced to concentrates of smelting grade.

Output from the Northern Illinois area in 1944 totaled 47,993 tons of crude ore yielding 3,123 tons of finished zinc concentrates and 131 tons of lead concentrates; production, in terms of recoverable metals, was 1,693 tons of zinc and 93 tons of lead, compared with 1,152 and 4 tons, respectively, in 1943. The Wisconsin output is given in the tables that follow.

Shippers of Wisconsin rougher jig concentrates to the Vinegar Hill mill in 1944 comprised the C. F. & H. Mining Co. (Mulcahy mine), New Lucky Hit Mining Co. (Coughlin, Wilkins), New Birkett Mining Co., Liberty Mining Co., Wipet Mining Co., and Nightingale tailing mill (Crahall tailings). The principal Wisconsin shippers of crude ore to the mill were Gill Bros. (James mine), Cuba Mining Co. Andrews, B. A. T., Mulcahy No. 2), Piquette Mining Co. (Trego), Meloy & Baker (Hoskins, Martin), Thompson Mining Co., Deuce Mining Co., Carter & Meloy (Leadmine), Van Gordon Mining Co. (Little Joe), Galena Level Mining Co., Mifflin Mining Co. (Defense), and Curwen Mining Co.

The Dodgeville Mining Co. operated steadily its leased group of Dodgeville city lots and 150-ton jig and flotation mill. The W. E. Faithorn mill at the Champion mine near New Diggings, equipped with jigs and flotation machines, operated on old tailings from May through September and on mine rock during November and December. The Little Benny Mining Co. Monroe mine and jig mill were operated from January to August; the jig concentrates were re-treated in the company flotation mill at New Diggings. The Chestnut Hill Zinc Co. treated old tailings in its 200-ton flotation mill near Shullsburg. The new Coker 2,000-ton tailing mill of the United Milling & Mining Co. at Livingston began operating in June and ran steadily after the equipment was adjusted and minor alterations were made. The mill is described in a recent publication.¹

The Bureau of Mines, in cooperation with the Geological Survey, continued its exploration program. Wisconsin properties drilled in 1944 included the Andrew and North Coker at Livingston, Bickford and Defense at Mifflin, Coughlin near Shullsburg, Crescent near Rewey, and Last Chance at Arthur. Geophysical prospecting was done in the Mifflin-Livingston area. At the old Gordon copper mine, Douglas County, the Bureau repaired an old shaft and unwatered, cleaned out, and explored underground workings in an effort to evaluate the showing of several fissures containing native copper. Mining will be conducted to obtain samples for mill tests in a mill erected at the mine.

¹ Pett, G. H., Large Scale Tailing Reclamation Plant in Southwestern Wisconsin: Min. Cong. Jour., vol. 11, No. 1, January 1945, pp. 28-32.

Mine production of lead and zinc in Wisconsin, 1940-44¹

Year	Lead concentrates		Zinc concentrates (sphalerite)		Metal content ²			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	621	\$34,852	10,875	\$447,396	445	\$44,500	5,770	\$727,020
1941.....	1,639	111,014	11,685	594,323	1,225	139,650	6,238	935,700
1942.....	1,092	104,896	17,449	1,028,828	775	103,850	9,426	1,753,236
1943.....	1,307	111,360	26,632	1,624,858	920	138,000	14,387	3,107,562
1944.....	1,954	166,853	28,696	1,892,313	1,415	226,400	15,549	3,545,172

¹ Most of the ore mined in Wisconsin in 1940-44 was first treated in gravity-concentration mills producing bulk concentrates which were re-treated by flotation.

² In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

³ Most of the finished zinc concentrates and part of the lead concentrates produced in Wisconsin in 1942-44 came from a custom mill treating purchased crude ores and low-grade bulk concentrates on which premium payments had been made previously to mine operators; therefore, the value of these concentrates is calculated at market prices. Premium payments not reflected in the value of the finished concentrates amounted to about \$399,000 in 1942, \$1,059,000 in 1943, and \$1,384,367 in 1944 for zinc and \$18,500, \$40,600, and \$71,498, respectively, for lead; part of these payments, however, were for ore which was stock-piled.

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Wisconsin, 1943-44

	1943		1944	
	Crude ore	Old tailings	Crude ore	Old tailings
Total ore, etc., milled..... short tons..	413,876	134,146	394,712	229,099
Total concentrates produced: ¹				
Lead..... do.....	1,306	1	1,954	
Zinc..... do.....	24,922	1,710	26,421	2,275
Ratio of concentrates to ore, etc.: ²				
Lead..... percent.....	0.32		0.50	
Zinc..... do.....	6.03	1.27	6.69	0.99
Metal content of ore, etc.: ³				
Lead..... do.....	.23		.37	
Zinc..... do.....	3.62	.75	4.04	.59
Average lead content of galena concentrates..... do.....	71.77	69.58	74.00	
Average zinc content of sphalerite concentrates..... do.....	60.09	58.95	60.31	58.99
Average value per ton: ⁴				
Galena concentrates.....	\$85.21	\$71.00	\$85.39	
Sphalerite concentrates.....	58.86	92.36	63.35	\$96.07

¹ Most of the ore mined in Wisconsin in 1943-44 was first treated in gravity-concentration mills producing bulk concentrates which were re-treated by flotation.

² Percentage represents finished flotation concentrates.

³ Percentages represent metal content of the ore insofar as it is recovered in the concentrates.

⁴ Most of the finished zinc concentrates and part of the lead concentrates produced in Wisconsin in 1943-44 came from a custom mill treating purchased crude ores and low-grade bulk concentrates on which premium payments had been made previously to mine operators; therefore, the value of these concentrates is calculated at market prices.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO

(MINE REPORT)

By RICHARD H. MOTE

SUMMARY OUTLINE

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SUMMARY

Colorado gold production in 1944 fell below that in any year since 1875. Except for the period 1931-33, silver production was the lowest since 1873. With the exception of 1943, production of zinc in 1944 was the largest in any year since 1918. The number of producing lode mines decreased from 235 in 1943 to 196 in 1944; the number of placer mines decreased from 17 to 13.

Comparing 1944 with 1943, gold decreased 19 percent and silver 16 percent in both quantity and value; lead decreased 2 percent in quantity but increased 5 percent in value; zinc decreased 9 percent in quantity and 4 percent in value; and copper increased 2 percent in quantity and 6 percent in value. The total value of the five metals was 8 percent less than in 1943; of the total value zinc represented 51 percent, gold 22 percent, lead 16 percent, silver 9 percent, and copper 2 percent.

Eagle County continued to lead the counties of the State in total value of output of the five metals and ranked first in production of zinc. Lake County continued in second place, was the largest producer of lead, and ranked second to Eagle County in production of zinc. San Juan County was in third place in 1944. Other counties of the leading six, listed in order of total value of output, were Dolores, San Miguel, and Teller. Of the 26 counties producing in 1944, these six contributed 82 percent of the total value of the five metals produced in the State.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold †	Silver ‡	Copper ‡	Lead ‡	Zinc ‡
	Per fine ounce	Per fine ounce	Per pound	Per pound	Per pound
1940	\$35.00	\$20.711+	\$0.113	\$0.050	\$0.063
1941	35.00	4.711+	.118	.057	.075
1942	35.00	4.711+	.121	.067	.093
1943	35.00	4.711+	.130	.075	.108
1944	35.00	4.711+	.135	.080	.114

Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 1, 1937, to Jan. 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.
 ‡ Treasury buying price for newly mined silver.
 ‡ 1944-45: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price paid by Metals Reserve Company for overquota production.

Annual figures for the 5 years ended with 1944 and total production from 1858 are given in the table that follows. To the end of 1944 Colorado had produced more silver than any other State, but the decreased output since that year has forced Colorado to yield first place to Montana.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1940-44, and total, 1858-1944, in terms of recovered metals

Year	Mines producing		Ore sold or treated (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1940.....	691	439	2,157,765	367,336	\$12,856,760	9,710,709	\$6,905,391
1941.....	579	324	2,222,786	380,029	13,301,015	7,301,697	5,192,311
1942.....	311	68	1,797,386	268,627	9,401,945	3,096,211	2,201,754
1943.....	235	17	1,631,318	137,558	4,814,530	2,664,142	1,894,501
1944.....	196	13	1,550,422	111,455	3,900,925	2,248,830	1,599,168
1858-1944.....	-----	-----	(¹)	38,814,395	852,380,789	725,959,747	564,176,591

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1940.....	24,304,000	\$2,746,352	22,952,000	\$1,147,600	10,120,000	\$637,560	\$24,293,661
1941.....	13,496,000	1,592,528	25,148,000	1,433,436	31,444,000	2,358,300	23,877,597
1942.....	2,204,000	266,684	30,362,000	2,034,254	64,430,000	5,991,990	19,896,623
1943.....	2,056,000	267,280	36,064,000	2,704,800	88,188,000	9,524,304	19,205,415
1944.....	2,096,000	282,960	35,396,000	2,831,680	79,910,000	9,109,740	17,724,473
1858-1944.....	1,247,472	65,316,123	1,242,802	232,266,447	1,267,278	186,212,730	1,900,352,684

¹ Figures not available.

² Short tons.

Gold and silver produced at placer mines in Colorado, 1940-44, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Drift mining		Dredges						Total	
					Dry-land ¹		Dragline floating		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1940.....	1,822	360	-----	-----	10,203	2,210	-----	-----	4,975	1,068	17,000	3,638
1941.....	1,886	402	-----	-----	13,052	2,580	4,817	553	10,622	2,152	30,377	5,687
1942.....	1,802	335	-----	-----	119	9	6,173	945	14,523	2,913	22,617	4,202
1943.....	521	90	-----	-----	-----	-----	-----	-----	-----	-----	521	90
1944.....	343	90	-----	-----	-----	-----	-----	-----	-----	-----	343	90

¹ Dragline and power-shovel excavators with sluices or special amalgamators.

Gold.—Mine production of recovered gold in Colorado decreased from 137,558 fine ounces in 1943 to 111,455 ounces in 1944. The principal gold-producing districts in 1944 were: Cripple Creek, Teller County, which produced 28 percent of the State output; Animas, San Juan County, 25 percent; California (Leadville), Lake County, 18 percent; Upper San Miguel, San Miguel County, 17 percent; Sneffels, Ouray County, 3 percent; Summitville, Rio Grande County, 2 percent; Ten Mile, Summit County, 1 percent; and Buckskin, Park County, 1 percent. Dry and siliceous ores yielded 83 percent of the State total gold; zinc-lead ore, 15 percent; and copper, lead, and zinc ores and small placer operations, 2 percent.

Silver.—Mine production of recovered silver in Colorado decreased from 2,664,142 fine ounces in 1943 to 2,248,830 ounces in 1944. The Creede district, Mineral County, continued to be the largest producer of silver and contributed 23 percent of the State total in 1944. Other principal silver-producing districts were: California (Leadville), Lake County, which produced 22 percent of the State output; Animas, San Juan County, 10 percent; Upper San Miguel, San Miguel County, 8 percent; Red Cliff, Eagle County, 6 percent; Roaring Fork, Pitkin County, 6 percent; Pioneer (Rico), Dolores County, 5 percent; Saffels, Ouray County, 4 percent; and Griffith, Clear Creek County, 4 percent. Dry and siliceous ores yielded 53 percent of the State total silver; zinc-lead ore, 42 percent; lead ore, 4 percent; and copper and zinc ores and small placer mines, 1 percent.

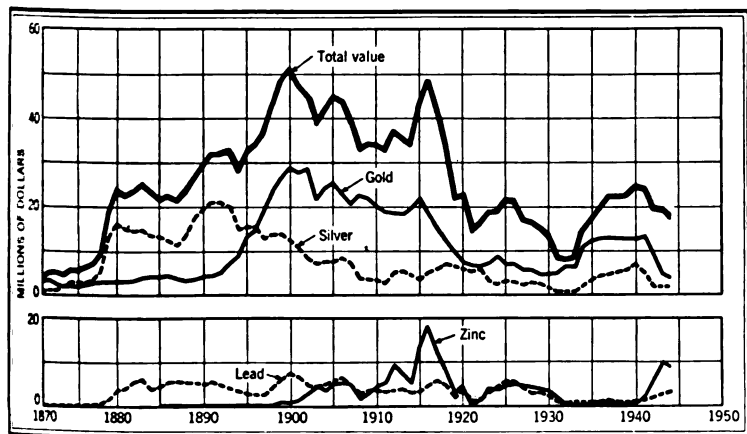


FIG. 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, and zinc in Colorado, 1870-1944. The value of copper has been less than \$2,000,000 annually, except a few years.

Copper.—The output of recovered copper from mines in Colorado in 1944 was 2,096,000 pounds compared with 2,056,000 pounds in 1943. With the exception of operations in Montrose County, virtually all the copper produced in the State in 1944 was recovered as a by-product from ores mined for their zinc, lead, or precious-metal content. Zinc-lead ore yielded 38 percent of the State total copper; dry and siliceous ores, 38 percent also; copper ore, 21 percent; and lead and zinc ores, 3 percent.

Lead.—The mine production of recovered lead in Colorado was 36,996,000 pounds in 1944 compared with 36,064,000 pounds in 1943. The Leadville district, Lake County, continued to be the largest lead-producing area in the State, followed by the Pioneer (Rico), Dolores County; Animas, San Juan County; Red Cliff, Eagle County; and Upper San Miguel, San Miguel County. The production from each of these districts exceeded 2,000,000 pounds of lead, and together they furnished 77 percent of the State output in 1944. Zinc-lead ore yielded 71 percent of the State total lead; dry and siliceous ores, over 23 percent; lead ore, nearly 6 percent; and copper and zinc ores, 0.11 percent.

Zinc.—The output of recovered zinc from mines in Colorado decreased from 88,188,000 pounds in 1943 to 79,910,000 pounds in 1944. The principal zinc-producing districts in 1944, in order of output, were:

Red Cliff, California (Leadville), Pioneer (Rico), Ten Mile, Upper San Miguel, Animas, Griffith, Buckskin, and Tomichi; these nine districts produced 93 percent of the State total output in 1944. Zinc and zinc-lead ores yielded 96 percent of the State total zinc, and dry and siliceous ores 4 percent.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1944, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Adams.....	.....	1	126	\$4,410	45	\$32
Boulder.....	11	.....	928	32,480	4,725	3,360
Chaffee.....	5	.....	164	5,740	7,342	5,221
Clear Creek.....	22	1	427	14,945	96,999	68,977
Custer.....	5	.....	99	3,465	11,496	8,175
Dolores.....	3	.....	141	4,935	121,791	86,607
Eagle.....	2	.....	448	15,680	134,211	95,439
Fremont.....	2	.....	52	1,820	436	310
Gilpin.....	10	5	476	16,660	14,227	10,117
Gunnison.....	6	.....	69	2,415	24,376	17,334
Hinsdale.....	1	.....	7	245	1,949	1,386
Jefferson.....	.....	2	6	210	1	1
Lake.....	24	.....	20,153	705,355	496,679	353,194
La Plata.....	1	.....	163	5,705	107	76
Mineral.....	9	.....	444	15,540	518,161	368,470
Montrose.....	1	.....	47	1,645	23,722	16,869
Ouray.....	13	.....	3,212	112,420	143,325	101,920
Park.....	9	2	2,300	80,500	15,826	11,254
Pitkin.....	5	.....	5	175	126,232	89,765
Rio Grande.....	2	.....	2,154	75,390	1,222	869
Routt.....	1	.....	5	175	1,007	716
Saguache.....	6	.....	70	2,450	27,149	19,306
San Juan.....	11	.....	28,523	998,305	233,027	165,708
San Miguel.....	5	.....	18,542	648,970	169,650	120,640
Summit.....	22	2	2,008	70,280	70,514	50,143
Teller.....	20	.....	30,886	1,081,610	4,611	3,279
Total, 1943.....	196	13	111,455	3,900,925	2,248,830	1,599,168
	235	17	137,558	4,814,530	2,664,142	1,894,501

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams.....	.....	.....	.....	.....	.....	.....	\$4,442
Boulder.....	9,400	\$1,269	107,300	\$8,584	33,000	\$3,762	49,455
Chaffee.....	10,000	1,350	194,000	15,520	333,000	37,962	65,793
Clear Creek.....	22,000	2,970	1,170,000	93,600	1,078,000	122,892	303,884
Custer.....	1,600	216	206,000	16,480	274,000	31,236	59,572
Dolores.....	237,000	31,995	5,653,000	452,240	9,114,000	1,038,096	1,614,773
Eagle.....	109,000	14,715	2,888,000	231,040	40,983,000	4,672,062	5,028,036
Fremont.....	22,000	2,970	40,000	3,200	907,000	103,398	111,698
Gilpin.....	36,800	4,968	197,000	15,760	170,000	19,380	66,885
Gunnison.....	33,000	4,455	838,000	67,040	878,000	100,092	191,336
Hinsdale.....	2,200	297	124,000	9,920	14,000	1,596	13,444
Jefferson.....	.....	.....	.....	.....	.....	.....	211
Lake.....	351,000	47,385	11,505,000	920,400	15,968,000	1,820,352	3,846,686
La Plata.....	.....	.....	.....	.....	.....	.....	5,781
Mineral.....	75,000	10,125	957,000	76,560	15,000	1,710	472,405
Montrose.....	403,000	54,405	700	56	.....	.....	72,975
Ouray.....	164,000	22,140	1,044,000	155,520	1,068,000	121,752	513,752
Park.....	53,000	7,155	160,000	12,800	1,121,000	128,136	239,645
Pitkin.....	1,200	162	465,000	37,200	352,000	40,128	167,430
Rio Grande.....	15,000	2,025	700	56	.....	.....	78,340
Routt.....	6,800	918	20,300	1,624	154,000	17,556	20,989
Saguache.....	45,000	6,075	625,000	50,000	500,000	57,000	134,531
San Juan.....	348,000	46,980	4,594,000	367,520	1,258,000	143,412	1,721,925
San Miguel.....	138,000	18,630	2,883,000	230,640	1,655,000	188,670	1,207,550
Summit.....	13,000	1,755	824,000	65,920	4,032,000	459,648	647,746
Teller.....	.....	.....	.....	.....	.....	.....	1,084,289
Total, 1943.....	2,096,000	282,960	35,396,000	2,831,680	79,910,000	9,109,740	17,724,473
	2,056,000	267,280	36,064,000	2,704,800	88,188,000	9,524,304	19,205,415

Ore sold or treated and gold and silver produced at lode mines in Colorado in 1944, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Adams	13,988	928	4,725
Alamosa	2,731	155	7,342
Archuleta	13,686	427	96,999
Aspen	4,760	99	11,496
Boulder	36,941	141	121,791
Chelan	201,544	448	134,211
Cheyenne	4,072	52	436
Crow	3,087	429	14,220
Custer	6,033	69	24,376
DeWeld	2,200	7	1,949
Dolores	686,551	20,153	496,679
Durango	8	163	107
El Paso	27,883	444	518,161
Essex	7,687	47	23,722
Garfield	32,062	3,212	143,325
Graham	12,468	2,206	15,826
Huerfano	14,625	5	126,232
La Plata	1,777	2,154	1,222
Lincoln	916	5	1,007
Logan	5,311	70	27,149
Mesa	176,695	28,523	233,027
Mineral	154,784	18,542	169,650
Monte Vista	27,048	1,857	70,477
Summit	113,565	30,886	4,611
Total 1943	1,550,422	111,112	2,248,740
	1,631,318	137,037	2,664,052

MINING INDUSTRY

The shortage of labor at the mines and mills in Colorado in 1944 was more critical than at any time since the entry of the United States into World War II and was the greatest single factor affecting the production of metals during the year. In addition to the general scarcity of labor, the quality of available replacements at the mines and mills was far below standard. Absenteeism in varying degrees of severity plagued virtually every producing property. Some of the larger operators reported absenteeism as high as 15 percent during certain periods of the year. The nonferrous metal-mining situation in Colorado in 1944, however, was not without some encouraging aspects, of which the most important were: The marked increase in output of zinc and lead in Lake County, the largest production in any year since 1930; the successful development program at the Colorado Mining Co. Black Bear mine in San Miguel County, carried out through extension of the Treasury tunnel (Ouray County), which opened up a large potential source of zinc-lead-copper ore; and the custom milling program of the Resurrection Mining Co., which stimulated the mining of zinc-lead ore in Summit and Lake Counties by providing a market for ore economically unprofitable for direct smelting.

The general policy of the Quota Committee pertaining to the premium-price plan for overquota production of domestic copper, lead, and zinc as revised in 1943 prevailed throughout 1944. The latter part of the year found the producers increasingly apprehensive over the future for premiums on these three metals. Specific concern was evident over the 30-day cancellation clause of all except the basic A premium.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Colorado in 1944, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore.....	557,810	88,621	460,792	578,134	6,372,159	3,113,761
Dry and siliceous gold-silver ore.....	20,930	3,509	54,838	44,976	394,636	-----
Dry and siliceous silver ore.....	62,124	576	670,406	179,072	1,553,062	352,000
	640,864	92,706	1,186,036	802,182	8,319,857	3,465,766
Copper ore.....	7,880	91	27,286	431,814	700	-----
Lead ore.....	11,123	1,313	90,844	27,267	1,951,418	-----
Zinc ore.....	5,939	167	3,544	32,336	37,529	1,352,953
Zinc-lead ore.....	884,616	16,835	941,030	802,401	25,086,496	75,091,282
	909,558	18,406	1,062,704	1,293,818	27,076,143	76,444,235
Total, lode mines.....	1,550,422	111,112	2,248,740	2,096,000	35,396,000	79,910,000
Total, placers.....	-----	343	90	-----	-----	-----
	1,550,422	111,455	2,248,830	2,096,000	35,396,000	79,910,000
Total, 1943.....	1,631,318	137,558	2,664,142	2,056,000	36,064,000	88,188,000

METALLURGIC INDUSTRY

Of the 1,550,422 tons of ore mined in 1944 in Colorado, 624,696 tons (40 percent) were treated at concentrating plants and 890,913 tons (58 percent) at amalgamation and cyanidation mills with concentrating equipment; 34,813 tons (2 percent) were shipped crude to smelters. The Arkansas Valley lead bullion-leady copper matte smelter at Leadville purchased most of the gold, silver, and gold-silver-lead-copper ore and concentrates shipped to smelters during the year. The quantity of zinc-lead ore sold or treated increased from 613,750 tons in 1943 to 884,616 in 1944, zinc ore from 4,378 tons to 5,939, and copper ore from 3,008 tons to 7,880; dry and siliceous ores decreased from 994,826 tons to 640,864, and lead ore from 15,291 tons to 11,123.

Of the ore treated at concentrating plants, 401,182 tons were zinc-lead ore, 147,165 tons dry gold ore, 50,679 tons dry silver ore, 20,872 tons dry gold-silver ore, 3,217 tons zinc ore, and 1,581 tons lead ore.

Mine production of metals in Colorado in 1944, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated ¹	810,091	35,323	7,510	-----	-----	-----
Sands and slimes cyanided ²	200,014	6,988	16,413	-----	-----	-----
Concentrates smelted.....	142,856	64,472	2,028,390	1,509,480	32,817,194	79,775,376
Ore smelted.....	34,813	4,329	196,427	586,520	2,578,806	134,624
Placer ³	-----	343	90	-----	-----	-----
	-----	111,455	2,248,830	2,096,000	35,396,000	79,910,000
Total, 1943.....	-----	137,558	2,664,142	2,056,000	36,064,000	88,188,000

¹ Quicksilver used by amalgamation mills was 1,812 pounds. Placer mines used approximately 12 pounds.

² Cyanide (in terms of 96 to 98 percent NaCN) used was 195,671 pounds.

³ Comprises 113,869 tons of sands and slimes from ore first roasted and amalgamated and 86,145 tons of selective-flotation tailings.

The destination and treatment of concentrates and ore produced by operators in the State are discussed in the following review by counties and districts.

All the placer gold and silver produced in Colorado in 1944 was recovered by small-scale hand methods. Figures for the quantity of gravel handled at these operations during the year are not obtainable.

The production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Colorado in 1944, in terms of recovered metals

BY COUNTIES

	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Aspen	1,557	282	115	64	278	1,242	600	20,900	33,000
Chama	1,735	11	149	317	57	2,942	6,511	28,203	235,221
Clear Creek	1,922	36	375	349	211	7,766	9,557	130,564	159,216
Cortez	4,633	14	443	501	81	8,730	1,600	145,848	274,000
Creighton	4,072	7	23	1,147	45	413	22,000	40,000	907,000
Delta	2,739	59	489	409	287	9,618	7,069	176,315	170,000
Empire	1,347	3	141	295	17	2,976	4,048	101,897	148,678
Gold	572,428	3,719	12,737	20,258	5,440	293,636	237,285	3,730,539	8,602,326
Idaho	25,804	1,632	461	2,292	1,348	99,491	110,800	954,000	752,500
Monte Vista	1,644	66	108	221	173	1,748	5,455	37,087	145,402
La Grande	1,769	633	15	231	1,474	1,143	15,000	-----	-----
Mapache	2,530	6	220	306	36	4,342	8,256	102,379	154,407
San Juan	2,657	12	200	736	72	3,911	13,228	199,694	416,828
San Miguel	139,784	4,787	2,506	10,840	11,470	136,639	102,593	2,574,910	1,655,000
Summit	12,727	158	1,330	2,462	865	26,112	4,099	258,110	1,784,606
Trinidad	113,565	30,886	4,611	-----	-----	-----	-----	-----	-----
Total 1944	890,913	42,311	23,923	40,428	21,854	600,609	548,101	8,500,446	15,438,184
	800,862	66,306	24,658	37,887	25,130	483,171	478,854	8,405,256	8,999,771

BY CLASSES OF ORE TREATED

Dry and siliceous									
Gold	405,235	41,635	8,705	19,162	18,047	300,261	295,452	3,818,506	2,555,064
Silver	2,688	4	-----	956	24	-----	16,000	-----	787,500
Lead-lead	482,990	672	15,218	20,310	3,783	300,348	236,649	4,681,940	12,095,620
	890,913	42,311	23,923	40,428	21,854	600,609	548,101	8,500,446	15,438,184

Mine production of metals from concentrating mills in Colorado in 1944, in terms of recovered metals

BY COUNTIES

	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder.....	12, 146	154	8	3, 091	3, 800	86, 400	8, 500
Chaffee.....	36	15	11	322	400	5, 600	909, 349
Clear Creek.....	11, 717	1, 891	155	86, 499	11, 143	1, 025, 206	9, 114, 000
Dolores.....	36, 941	14, 650	141	121, 791	237, 000	5, 653, 000	40, 983, 000
Eagle.....	198, 491	49, 618	180	92, 936	10, 515	2, 866, 572	729, 322
Gunnison.....	4, 500	1, 405	48	18, 360	28, 952	648, 336	14, 000
Hinsdale.....	2, 200	127	7	1, 949	2, 200	124, 000	7, 365, 674
Lake.....	98, 136	16, 818	8, 248	134, 561	94, 994	6, 323, 590	15, 000
Mineral.....	25, 512	2, 215	244	485, 174	71, 244	713, 125	315, 500
Ouray.....	5, 475	1, 196	202	35, 688	42, 377	855, 639	978, 598
Park.....	10, 674	1, 931	1, 958	13, 547	45, 245	122, 637	352, 000
Pitkin.....	12, 853	845	5	119, 236	1, 200	432, 749	154, 000
Routt.....	916	207	5	1, 007	6, 800	20, 300	345, 593
Saguache.....	2, 093	582	20	15, 204	27, 123	226, 368	841, 172
San Juan.....	173, 953	6, 657	28, 434	228, 538	334, 614	4, 369, 521	64, 337, 192
San Miguel.....	15, 000	1, 109	2, 285	30, 605	35, 407	308, 090	79, 138, 323
Summit.....	14, 053	3, 008	667	39, 273	8, 365	535, 615	
Total, 1943.....	624, 696	102, 428	42, 618	1, 427, 781	961, 379	24, 316, 748	
	787, 827	116, 494	40, 978	1, 919, 267	1, 163, 389	24, 103, 449	

BY CLASSES OF ORE TREATED

Dry and siliceous gold.....	147, 165	4, 164	26, 419	131, 785	260, 471	2, 123, 981	558, 701
Dry and siliceous gold-silver.....	20, 872	1, 406	3, 492	52, 901	44, 976	393, 751	
Dry and siliceous silver.....	50, 679	3, 212	253	608, 049	76, 644	1, 222, 276	352, 000
Lead.....	1, 581	188	25	10, 376	1, 261	192, 381	
Zinc.....	3, 217	675	135	3, 357	16, 200	34, 888	552, 386
Zinc-lead.....	401, 182	92, 783	12, 294	621, 313	561, 827	20, 349, 471	62, 874, 105
Total, 1943.....	624, 696	102, 428	42, 618	1, 427, 781	961, 379	24, 316, 748	64, 337, 192

Gross metal content of concentrates produced from ores mined in Colorado in 1944, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (wet assay) (pounds)	Lead (wet assay) (pounds)	Zinc (pounds)
Dry gold.....	240	537	1, 723	5, 130	15, 747	
Copper.....	231	1, 474	1, 143	15, 268		
Lead.....	44, 918	47, 004	1, 688, 107	906, 401	31, 955, 978	4, 171, 910
Lead-copper.....	2, 660	11, 495	102, 574	329, 848	1, 508, 252	78, 643
Total to copper and lead plants.....	48, 049	60, 510	1, 793, 547	1, 256, 647	33, 479, 977	4, 250, 553
Zinc.....	92, 361	3, 828	201, 671	547, 037	2, 202, 169	90, 350, 332
Zinc-lead.....	2, 446	1, 367	102, 178	134, 096	1, 116, 451	1, 092, 531
Total to zinc plants.....	94, 807	5, 195	303, 849	681, 133	3, 318, 620	91, 442, 863
Total, 1943.....	142, 856	65, 705	2, 097, 396	1, 937, 780	36, 798, 597	95, 693, 416
	154, 381	67, 137	2, 480, 054	2, 065, 687	36, 566, 879	98, 172, 835

GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO 309

The production of metals from Colorado concentrates shipped to smelters in 1944, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Adams	218	286	4,333	4,400	107,300	33,000
Alamosa	332	68	3,264	6,911	33,803	243,721
Aspen	2,240	366	94,265	20,700	1,155,770	1,068,555
Boulder	501	81	8,730	1,600	145,848	274,000
Butte	14,650	141	121,791	237,000	5,653,000	9,114,000
Chama	49,618	180	92,936	10,515	2,866,572	40,983,000
Colorado	1,147	45	413	22,000	40,000	907,000
Crow	409	287	9,618	7,099	176,315	170,000
Del Norte	1,700	65	21,336	33,000	750,233	878,000
Durango	127	7	1,949	2,200	124,000	14,000
East	37,076	13,688	428,197	332,279	10,054,129	15,968,000
El Paso	2,215	244	485,174	71,244	713,125	15,000
Essex	3,488	1,550	135,179	153,177	1,809,639	1,068,000
Garfield	2,152	2,131	15,295	60,700	159,724	1,124,000
Graham	845	5	119,236	1,200	432,749	352,000
Huerfano	231	1,474	1,143	15,000		
La Plata	207	5	1,007	6,800	20,300	154,000
Lincoln	888	56	19,546	35,379	328,747	500,000
Logan	7,393	28,506	232,449	347,842	4,569,215	1,258,000
Monte Vista	11,949	13,755	167,144	138,000	2,843,000	1,655,000
Summit	5,470	1,532	65,385	12,464	793,725	3,996,100
Total 1943	142,856	64,472	2,028,390	1,509,480	32,917,194	79,775,376
	154,381	66,108	2,402,438	1,642,243	32,508,705	88,138,094

BY CLASSES OF CONCENTRATES SMELTED

	Gold	Silver	Copper	Lead	Zinc
Gold	240	537	1,723	3,633	13,983
Silver	231	1,474	1,143	15,000	
Copper	44,918	47,004	1,688,099	718,171	28,874,382
Lead	2,660	11,495	102,574	260,969	1,364,690
Total to copper and lead plants	48,049	60,510	1,793,539	997,773	30,253,055
Gold	92,361	2,595	132,673	397,781	1,478,149
Silver	2,446	1,367	102,178	113,926	1,085,990
Total to zinc plants	94,807	3,962	234,851	511,707	2,564,139
Total 1943	142,856	64,472	2,028,390	1,509,480	32,817,194
					79,775,376

Crude metal content of Colorado crude ore shipped to smelters in 1944, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Gold and siliceous gold	5,410	2,520	20,041	27,753	477,462	
Gold and siliceous gold-silver	58	17	1,937		983	
Gold and siliceous silver	11,445	323	62,357	116,504	369,593	
Silver	7,890	91	27,286	442,674	1,265	
Copper	9,542	1,288	80,468	32,502	1,949,654	112,488
Total to copper and lead plants	34,335	4,239	192,089	619,433	2,798,957	112,488
Gold	34	4	187	161	2,688	18,469
Silver	444	86	4,151	4,636	55,694	172,127
Total to zinc plants	478	90	4,338	4,797	58,382	190,596
Total 1943	34,813	4,329	196,427	624,230	2,857,339	303,084
	42,629	4,623	236,989	464,076	3,950,530	208,170

*Mine production of metals from Colorado crude ore shipped to smelters in 1943
in terms of recovered metals*

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder.....	285	360	277	5,000		
Chaffee.....	960	76	3,929	3,089	160,197	89,27
Clear Creek.....	47	25	2,359	1,300	14,230	9,44
Custer.....	127	4	2,323		60,152	
Eagle.....	3,053	268	41,275	98,485	21,428	
Gilpin.....	348	83	4,113	29,731	20,685	
Gunnison.....	186	1	2,899		87,767	
Lake.....	15,987	2,746	55,745	18,721	1,450,871	
La Plata.....	8	163	107			
Mineral.....	2,371	200	32,987	3,756	243,875	
Montrose.....	7,687	47	23,722	403,000	700	
Ouray.....	783	30	7,685	10,823	134,361	
Park.....	150	99	423	2,300	276	
Pitkin.....	1,772		6,996		32,251	
Rio Grande.....	8	47	64		700	
Saguache.....	688	8	7,383	9,621	296,253	
San Juan.....	85	5	378	158	24,785	
Summit.....	268	167	3,762	536	30,275	35,90
Total, 1943.....	34,813	4,329	196,427	586,520	2,578,806	134,624
	42,629	4,623	236,956	413,757	3,555,295	49,90

BY CLASSES OF ORE

Dry and siliceous gold.....	5,410	2,520	20,041	22,211	429,672	
Dry and siliceous gold-silver.....	58	17	1,937		885	
Dry and siliceous silver.....	11,445	323	62,357	102,428	330,786	
Copper.....	7,880	91	27,286	431,814	700	
Lead.....	9,542	1,288	80,468	26,006	1,759,037	
Total to copper and lead plants.....	34,335	4,239	192,089	582,459	2,521,080	
Zinc.....	34	4	187	136	2,641	13,067
Zinc-lead.....	444	86	4,151	3,925	55,085	121,557
Total to zinc plants.....	478	90	4,338	4,061	57,726	134,624
	34,813	4,329	196,427	586,520	2,578,806	134,624

REVIEW BY COUNTIES AND DISTRICTS
Mine production of gold, silver, copper, lead, and zinc in Colorado in 1944, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Adams County.....		1				126			45				\$4,442
Boulder County:													
Central.....	1		12,146			8							9,903
Gold Hill.....	5		1,311	340		340	3,091		3,091	3,800	86,400		18,343
Sugar Loaf.....	3		246	226		226	1,305		1,305	600	20,900	33,000	7,737
Ward.....	2		285	360		360	62		62	5,000			13,472
Chaffee County:													
Chalk Creek.....	1		36	11		11	322		322	400	5,600	8,500	2,985
Granite.....	1	1	(1)	1		9							350
Monarch.....	3		2,695	143		143	7,020		7,020	9,600	188,400	324,500	63,358
Clear Creek County:													
Argentine.....	1		998	66		66	803		803	600	78,900	14,000	10,870
Griffith.....	4		10,119	61		61	83,676		83,676	9,000	928,500	880,400	238,325
Idaho Springs.....	11		2,017	226		226	10,658		10,658	10,800	113,600	139,600	41,949
Montana.....	3		261	8		8	775		775	4,500	4,500		1,140
Trail Creek.....	3		4,760	69		69	1,087		1,087	1,200	46,500	35,000	10,900
Custer County: Hardscrabble.....	3		36,941	99		99	11,466		11,466	1,600	206,000	274,000	59,572
Dolores County: Pioneer (Rico).....	5		201,544	141		141	121,791		121,791	237,000	5,653,000	9,114,000	1,614,773
Eagle County: Red Cliff.....	2			448		448	134,211		134,211	109,000	2,888,000	40,983,000	5,028,390
Fremont County:													
Cotopaxi.....	1		2,688	28		28				16,000		787,500	92,915
Grape Creek.....	1		1,384	24		24	436		436	6,000	40,000	119,500	18,783
Gilpin County:													
Southern.....	9	5	3,087	421	47	468	14,219	7	14,226	36,800	197,000	170,000	66,604
Northern.....	1		(1)	8		8	1		1				281
Gunnison County:													
Rock Creek.....	2		121	1		1	464		464	600	11,600	16,200	3,321
Taylor Park.....	2		144	67		67	2,089		2,089		80,800		8,411
Tomichi.....	2		5,708	7		7	21,223		21,223	32,400	735,000	861,800	179,704
Hinsdale County: Galena.....	1		2,200	7		7	1,949		1,949	2,200	124,000	14,000	13,444
Jefferson County:													
Lake County:		2			6	6		1					211
California (Leadville).....	23		686,548	20,149		20,149	496,634		496,634	351,000	11,505,000	15,968,000	3,846,514
St. Kevin.....	1		3	4		4	45		45				172
La Plata County: California.....	1		8	163		163	107		107				5,781
Mineral County: Creede.....	9		27,883	444		444	518,161		518,161	75,000	957,000	15,000	472,405
Montrose County: La Sal.....	1		7,687	47		47	23,722		23,722	403,000			72,975

1 Less than 1/4 ton.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1944, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Ourray County:													
Red Mountain	7		2,007	93		93	16,176			40,400	337,800	172,500	\$95,901
Sneffels	1		23,804	2,980		2,980	99,952			110,800	954,000	752,500	332,440
Uncompahgre	5		4,251	139		139	27,197			12,800	652,200	143,090	94,411
Park County:													
Beaver Creek		1			2	2							70
Bucksin	3		5,614	1,467		1,467	12,008			35,400	121,000	885,090	175,347
Consolidated Montgomery	1		577	193		193	1,042			5,000	1,000	10,600	9,459
Fairplay		1			2	2							70
Mosquito	4		4,923	622		622	2,776			3,800	35,000	103,400	39,267
Pulver	1		1,354	14		14				8,800	2,000	121,000	15,632
Pitkin County: Roaring Fork	5		14,625	5		5	126,232			1,200	455,000	352,000	167,430
Rio Grande County: Summitville	2		1,777	2,154		2,154	1,222			15,000	700		78,340
Routt County	1		916	5		5	1,007			6,800	20,300	154,000	20,989
Saguache County: Kerber Creek	6		5,311	70		70	27,149			45,000	625,000	500,000	134,831
San Juan County:													
Animas	7		175,117	28,450		28,450	228,015			337,000	4,472,000	1,153,090	1,692,591
Eureka	3		1,376	60		60	3,527			8,000	92,500	92,000	23,576
Ice Lake Basin	1		202	13		13	1,435			3,000	21,500	13,000	5,758
San Miguel County: Upper San Miguel	5		154,784	18,542		18,542	169,650			138,000	2,883,000	1,655,090	1,207,550
Summit County:													
Breckenridge	4	2	1,912	275	151	427	9,824	37		6,600	97,600	635,090	103,046
Green Mountain	1		621	16		16	1,785			7,700	207,500	20,182	24,182
Monteruma	10		2,118	19		19	11,413			3,800	232,400	223,500	53,365
Ten Mile	1		22,387	1,544		1,544	47,385			2,000	482,300	2,953,000	464,714
Wilkinson	2		10	2		2	69				4,000		4,483
Teller County: Cripple Creek	20		113,565	30,886		30,886	4,611						1,084,289
Total Colorado	196	13	1,550,422	111,112	343	111,455	2,248,740	90	2,248,830	2,095,000	35,395,000	79,910,000	17,724,473

ADAMS COUNTY

Sand and gravel handled in the washing plant of the Brannan Sand & Gravel Co. on Clear Creek north of Denver yielded gold as a byproduct in sluices operated throughout 1944 by a lessee.

BOULDER COUNTY

Central (Jamestown) district.—All gold, silver, copper, and lead produced in the Central district in 1944 were recovered as byproducts of fluorspar mining. The Argo, Brown Spar, and Emmett mines were operated by H. M. Williamson & Son for the production of fluorspar; lead-silver concentrates recovered from the milling of the fluorspar were shipped to the Leadville smelter.

Gold Hill district.—Virtually all the zinc produced in the Gold Hill district and Boulder County in 1944 came from the Gardner mine, worked under lease by Griswold & Stromberg throughout the year. A total of 972 tons of ore containing 351 ounces of gold, 1,394 ounces of silver, 1,058 pounds of copper, 31,932 pounds of lead, and 45,986 pounds of zinc was shipped to the Golden Cycle custom mill at Colorado Springs. Other mines that shipped to the Golden Cycle mill were the Black Cloud, Tammany, and Home Sweet Home. W. E. Brewster made one small shipment of bullion to the Denver Mint from the Henna property.

Sugar Loaf district.—All the ore produced in the Sugar Loaf district in 1944 was shipped to the Golden Cycle mill for treatment. The Alpine Horn mine, largest producer of gold in the district in 1944, was operated for 6 months during the year by L. E. and P. C. Ward. Small production was reported from the Nancy group and the Poor-man mines.

Ward district.—The Ward United Mines Co. operated the Utica and Boston mines until August, when lack of manpower and equipment forced the operators to close the property; 260 tons of dry gold ore containing 346 ounces of gold, 263 ounces of silver, and 6,154 pounds of copper were shipped to the Leadville smelter. The company 25-ton concentration-flotation mill was not operated during 1944. An operator on the Idaho claim made one small shipment to the Leadville smelter.

CHAFFEE COUNTY

Chalk Creek district.—M. K. McIver, lessee on the Mary Murphy mine, shipped 36 tons of zinc-lead ore containing nearly 12 ounces of gold, 354 ounces of silver, 536 pounds of copper, 6,149 pounds of lead, and 12,155 pounds of zinc to a custom mill at Midvale, Utah. During the summer of 1944 the Minerals Recovery Co. of Houston, Tex., installed a 1,000-ton Humphreys spiral gravity-concentration plant at the Mary Murphy mill to treat old mill tailings on the property. Severe winter weather prevented the plant from operating in 1944.

Granite district.—The production of the Granite district in 1944 came from a small lot of amalgam shipped to the Denver Mint from the Monogram lode by Leland A. Wilcox.

Monarch district.—The largest producer of gold, silver, copper, and zinc in Chaffee County in 1944 was the Garfield mine 1 mile north of Garfield, operated continuously throughout the year by Burleson Bros. A total of 1,735 tons of zinc-lead ore containing 89 ounces of gold, 4,784 ounces of silver, 15,981 pounds of copper, 48,674 pounds of

lead, and 381,719 pounds of zinc was shipped to the Golden Cycle mill for treatment. The Hawkeye mine, also operated by Burleson Bros., was a consistent producer of crude lead ore which was shipped to the Leadville smelter. Several shipments of old smelter slag were sent from the Salida smelter site to a lead smelter in Utah.

CLEAR CREEK COUNTY

Argentine district.—The only productive operation in the Argentine district in 1944 was that of O. Barlow Wilmarth on the National, Sussex, and Newcastle claims in Grizzly Gulch 8 miles southwest of Georgetown. Zinc-lead ore produced was concentrated at the Chicago Creek custom mill; the bulk concentrate was shipped to the Midvale (Utah) custom concentrator for further treatment.

Griffith district.—The largest producer of zinc and lead in the Griffith district and in Clear Creek County was the Mendota mine at Silver Plume, operated continuously during 1944 by Wallace K. Howard. The ore produced was treated in the 60-ton Watrous gravity-concentration mill; zinc-lead concentrates were shipped to the Midvale (Utah) custom concentrator for further treatment, and lead concentrates were shipped to the Leadville smelter. The Mile High Mining Co. continued to operate the Smuggler mine and Silver Leaf mill throughout 1944. Zinc and lead concentrates were produced and shipped to the Amarillo (Tex.) and Leadville smelters. A small tonnage of lead ore from the Dives-Pelican mine at Silver Plume was treated at the Commonwealth mill north of Georgetown. Several truckloads of lead ore from the New Boston mine were treated at the Golden Cycle mill.

Idaho Springs district.—Nearly 81 percent of the ore mined at the 11 producing properties in the Idaho Springs district in 1944 was milled at the Golden Cycle mill in Colorado Springs. Several custom mills in the district operated intermittently during the year; these were the Chicago Creek, Silver Spruce, and Ruth. The Golden Cycle mill received ore shipments during the year from the Idaho Bride, Brighton, Silver Age, Franklin 73, East Lake, Bald Eagle, and Stanley mines. Crude smelting ore was shipped to the Leadville and Tooele (Utah) smelters from the Idaho Bride, Oregon, Silver Age, Franklin 73, Silver Gem, and Salisbury properties.

Montana district.—Edgar Endy shipped to the Leadville smelter one small lot of dry gold-silver ore recovered during development at the Rainbow mine. Lead concentrates recovered from the milling of dry silver ore from the Silver King mine and Jo Reynolds dump were shipped to the Leadville smelter.

Trail Creek district.—The Harrison Croesus Mining Co. operated the Ben Harrison and Croesus claims on Trail Creek 4 miles southwest of Idaho Springs from June 28 to December 31, 1944. Zinc-lead sulfide ore totaling 249 tons was concentrated at the Golden Cycle mill in Colorado Springs. Ore recovered during development at the Lone Tree and Diamond Mountain properties was concentrated at local custom mills; concentrates produced were shipped to the Leadville smelter.

CUSTER COUNTY

Hardscrabble district.—The Lady Franklin mine near Westcliffe, largest producer of gold, silver, lead, and zinc in Custer County in 1944, was operated until July 1 by A. M. Poston and from September

through December by George L. Beardsley. A total of 3,648 tons of zinc-lead ore was shipped to the Golden Cycle mill for concentration. Crude zinc-lead ore also was shipped to the Golden Cycle mill from the Keystone and Bull Domingo mines. H. R. Henning operated the Defender property intermittently during the year; 120 tons of lead ore containing 4 ounces of gold, 2,217 ounces of silver, and 53,588 pounds of lead were shipped to the Leadville smelter. A small lot of lead ore also was shipped to the Leadville smelter from the Passiflora mine.

DOLORES COUNTY

Pioneer district (Rico).—The Rico Argentine Mining Co. operated its group of mines and 135-ton selective-flotation mill continuously in 1944 and shipped lead concentrates to the Leadville and zinc concentrates to the Amarillo (Tex.) smelters. Three shafts (the Atlantic Cable, Van Winkle, and Argentine No. 2) and three tunnels (the Blaine, Pro Patria, and Revenue) were in use during the year. Ore milled totaled 36,558 tons averaging 17 percent zinc and 10 percent lead. In addition to the usual wartime operating difficulties, the company was burdened with several problems uncommon in ordinary mining operations. The narrow-gage railroad serving the Rico area threatened to discontinue service for lack of operating capital; in order to get service from the county the company was forced to provide a substitute for the county treasurer, subsidize an undersheriff for policing the community, and provide funds for the teachers in the community public school. Markey Bros. operated the Yellow Jacket group under lease from the Rico Argentine Mining Co. and shipped crude zinc-lead ore to the Midvale (Utah) concentrator. Zinc-lead ore also was shipped to the Midvale mill from the Swan dump.

EAGLE COUNTY

Red Cliff district (Battle Mountain).—The Red Cliff district produced 51 percent of the total output of recovered zinc in Colorado in 1944 and continued to rank first among Colorado districts in value of production of the five metals. The New Jersey Zinc Co. Empire Zinc Division operated its Eagle mine and 600-ton underground selective-flotation mill continuously during the year. Zinc concentrates were shipped to the company smelters at Depue, Ill., and Palmerton, Pa., and lead concentrates were shipped to the Leadville smelter. Copper-iron-silver-gold sulfide ore was shipped to the Leadville smelter and the Garfield (Utah) and Murray (Utah) smelters.

EL PASO COUNTY

GOLDEN CYCLE MILL

The Golden Cycle mill at Colorado Springs operated throughout the year on company and custom ores from nearly all mining districts in the State; 221,543 tons of ore were treated in 1944 as compared with 287,939 tons in 1943. Of the total ore treated, 113,565 tons (226,908 tons in 1943) were company and custom gold-[silver]-sulfotelluride ores from the Cripple Creek district (Teller County), and 107,978 tons (61,031 tons in 1943) were miscellaneous zinc-lead and gold ores from Boulder, Chaffee, Clear Creek, Custer, Fremont,

Gilpin, Gunnison, Lake, Park, Pitkin, Saguache, San Juan, and Summit Counties. The 500-ton selective-flotation unit of the mill handled 107,561 tons of zinc-lead sulfide ores in 1944. The ores purchased vary in character; consequently, the metallurgy is not always the same. Ores from Cripple Creek are roasted, amalgamated,¹ and cyanided. Complex ores containing base metals are treated by selective flotation; the tailings from this operation are separated into sand and slimes and cyanided.

FREMONT COUNTY

Cotopaxi district.—The Monarch Galena Co. operated the Cotopaxi mine in the Cotopaxi district throughout 1944 and shipped 2,688 tons of zinc ore containing 37 ounces of gold, 39,404 pounds of copper, and 1,278,274 pounds of zinc to the Golden Cycle mill. The mine is developed by a 400-foot tunnel; 200 feet of drifts were driven during the year.

Grape Creek district.—Christison & Van Buskirk operated the Horseshoe mine, 9 miles southwest of Canon City, throughout 1944; 1,384 tons of zinc-lead ore containing 33 ounces of gold, 672 ounces of silver, 15,005 pounds of copper, 68,698 pounds of lead, and 194,296 pounds of zinc were shipped to the Golden Cycle mill.

GILPIN COUNTY

Southern districts (Blackhawk, Central City, Nevadaville, Russell Gulch).—The Widow Woman mine, operated throughout 1944 by the G. S. & G. Mining Co., was the largest producer in Gilpin County. Zinc-lead sulfide ore was shipped to the Golden Cycle mill for concentration. The Lu Ev Mining Co. mined the Hope and Powers claims throughout the year and shipped copper ore to the Garfield (Utah) smelter. The Boodle mine was active, and in addition to shipping zinc-lead ore to the Golden Cycle mill the operators continued work on the Boodle mill. Other properties that shipped ore to the Golden Cycle mill included the Jennie Blanch, West Notaway, Meeker-Success, and Cleveland mines. Lead ore was shipped to the Leadville smelter from the Cleveland, Jennie Blanch, Philadelphia, and Meeker-Success mines. Intermittent work at the Old Town group yielded 78 tons of dry gold ore which were shipped to the Leadville and Garfield (Utah) smelters.

Northern district.—A clean-up at the Perigo mill yielded a small amount of amalgam bullion which was shipped to the Denver Mint.

GUNNISON COUNTY

Rock Creek district.—The Colorado Zinc Co. leased and operated the Lucky Boy mine near Marble in October and November 1944. Zinc-lead ore totaling 44 tons and containing 167 ounces of silver, 4,686 pounds of lead, and 11,805 pounds of zinc was shipped to a custom concentrator at Bauer, Utah. A small lot of lead ore was shipped to the Leadville smelter. A. J. Betz worked the Catalpa mine from June 15 to December 31; 73 tons of zinc-lead ore containing 1 ounce of gold, 374 ounces of silver, 1,316 pounds of copper, 8,954 pounds of lead, and 12,760 pounds of zinc were shipped to the Golden Cycle mill and the Bauer (Utah) custom concentrator.

¹ Free gold is saved on lightweight cotton-flannel blankets and amalgamated in an iron arrastre.

Taylor Park district.—John Lambertson operated the Star mine on Italian Mountain continuously during 1944; 117 tons of lead ore were shipped to a smelter in Utah. Lambertson also worked the Bull Domingo claim and shipped 27 tons of lead ore to the Leadville smelter.

Tomichi district.—The Callahan Zinc-Lead Co. continued to operate its Akron mine at White Pine during 1944. Production came from the Erie-Sunset and Lost Contact claims. The mine is developed by a 3,000-foot tunnel with 250 feet of raises and 400 feet of drifts; 350 feet of new drifts and 250 feet of tunnel were completed during the year.

HINSDALE COUNTY

Galena district.—The Base Metal Corp. operated the Ute and Ulay group and 100-ton selective-flotation mill from April 15 to October 1. Zinc-lead ore milled totaled 2,200 tons and yielded 127 tons of zinc-lead concentrates.

LAKE COUNTY

California (Leadville) district.—One furnace of the American Smelting & Refining Co. Arkansas Valley lead bullion-lead copper matte smelter was operated continuously throughout 1944. Except for a small shipment of concentrates received from South Dakota, all material treated came from Colorado mines. Receipts of ore and concentrates totaled 67,960 tons, compared with 80,433 tons in 1943.

The Resurrection Mining Co. maintained continuous production at its Resurrection mine and 600-ton selective-flotation mill during the year. The mill has two 300-ton units (one completed in January 1944), but only one operated most of the year. In addition to concentrating Resurrection ore, the mill treated custom ore from producers in the Ten Mile, Breckenridge, and Montezuma districts, Summit County; the Griffith district, Clear Creek County; and from the Leadville district. The Resurrection mine is developed by the 1,323-foot Resurrection vertical shaft (six operating levels) and the 4-mile Yak tunnel, which connects the mill with the main shaft at the 850-foot level. Development completed during the year included 208 feet of inclined winze, 1,670 feet of drifts, 869 feet of raises, and 3,192 feet of diamond drilling.

The Ore & Chemical Co. 1,000-ton Heavy Media separation plant was operated continuously in 1944 on ores from the South Moyer, Tucson, Accident, Colonel Sellers, Greenback, and Wolfstone dumps. Approximately 375,000 wet tons of dump material were treated, resulting in the production of about 41,000 tons of bulk concentrates, which were shipped to the Golden Cycle mill at Colorado Springs for selective flotation. The California Gulch Mining & Milling Co. operated its two gravity- and flotation-concentration and amalgamation mills—one 75- to 125-ton capacity and one 450-ton capacity—throughout the year on ores from the Ibex and Colonel Sellers dumps. John Hamm Mining & Milling, Ltd., operated its 600-ton gravity-concentration mill the entire year on ore from the Wolfstone and Maid of Erin dumps. Bulk concentrates produced were shipped to the Resurrection Mining Co. and Golden Cycle mills for further concentration.

The Golden Cycle mill at Colorado Springs also treated ore from the Fortune and Little Johnny mines. The principal shippers of

smelter ore to the Leadville smelter (in approximate order of tonnage) were the Ibox, Dolly B, Commerce, New Monarch, Rock & Dome, Golden Eagle, Little Ellen, Valley, Adelaide, Little Johnny, Tucson, and Treasure Vault dump.

Operations at the projected 17,000-foot Leadville drainage tunnel continued on a three-shift basis throughout the year. Progress was slower than anticipated owing to the fractured condition of the rocks, making it necessary to gunite and concrete the walls of the tunnel at some points to consolidate the rocks and check the flow of water. At approximately 2,200 feet from the portal, a cave occurred that could not be controlled. The heading was bulkheaded and the bad ground bypassed successfully. At the end of 1944 the tunnel heading had advanced 2,673 feet from the portal and was being driven in the Gilman sandstone formation which permitted more rapid progress.

LA PLATA COUNTY

California (or La Plata) district (Hesperus, La Plata).—Bert Thompson worked the Bessie G mine and shipped 8 tons of dry gold ore, containing 163 ounces of gold and 107 ounces of silver, to the Midvale (Utah) smelter.

MINERAL COUNTY

Creede district.—The Emperius Mining Co., which in 1944 controlled nearly all mining properties in the Creede district, operated its 100-ton flotation mill the entire year on ore from the Amethyst, Bachelor, Commodore, Equinox, New York, Last Chance, Del Monte, Aspen, Happy Thought, and Robinson mines. Lead-silver-gold concentrates produced were shipped to the smelter at Leadville. The company also shipped lead-silver ore to the Leadville smelter from the Amethyst, Commodore, Last Chance, Del Monte, Aspen, and Robinson mines. The company continued work on its transportation tunnel at the lower end of Willow Creek Canyon; over 1 mile of the proposed 2½ miles of the tunnel has been completed. A complete surface plant, consisting of ore bins, machine and blacksmith shops, lighting plant, drying and sorting rooms, compressor plant, and locomotive shops, is near completion at the portal. The Ridge Leasing Co. operated the Ridge mine during the first part of the year and shipped 92 tons of zinc-lead ore to the Midvale (Utah) custom concentrator.

MONTROSE COUNTY

La Sal district.—The New Cashin Mines, Inc., operated the Cashin group of claims throughout the year and shipped 7,687 tons of copper fluxing ore to the Garfield (Utah) smelter.

OURAY COUNTY

Red Mountain district.—Seven mines were producing in the Red Mountain district in 1944. Among the larger operators were Red Mountain Mines, Inc., which shipped ore from the Genesee-Vanderbilt and Yankee Girl claims to the Leadville and Midvale (Utah) smelters and to the Midvale (Utah) custom concentrator; and the Denver Engineering Co., which operated the San Antonio mine through the Koehler tunnel at the top of Red Mountain Pass during

the early part of the year. Other producers shipping ore to the Leadville smelter and to the Midvale (Utah) custom mill were the Balm of Gilead, Lost Day, Yankee Boy, Beaver-Belfast, and Ida L mines.

Sneffels district.—The largest producer in Ouray County in 1944 was the Camp Bird mine and 100- to 125-ton amalgamation-flotation mill operated by King Lease, Inc. (See Minerals Yearbook, 1941, p. 348, for methods of ore treatment.) Concentrates were shipped to the International Smelting & Refining Co. lead smelter at Tooele, Utah; bullion produced was shipped to the Denver Mint. Development during the year included 443 feet of raises, 225 feet of drifts, and 763 feet of diamond drilling.

Uncompahgre district.—The Franz brothers, operating as the General Ore Reduction Co., continued to run their custom mill in Ouray in 1944. Lack of ore curtailed operations during the year. Lead-silver-zinc concentrates produced were shipped to the Midvale (Utah) mill and smelter. The McCullough Lease continued to treat old mill tailings from the Wanakah dump and to ship the concentrates to the Midvale (Utah) smelter. Julius Sonza, operating the Bachelor Consolidated mine under lease, installed a hoist and retimbered and relined the Bachelor shaft. Ore produced during the year was milled at the General Ore Reduction Co. mill. E. W. Creel operated the Micky Breen mine in Poughkeepsie Gulch from May 15 to December 31; 1,135 tons of zinc-lead ore were shipped to the General Ore Reduction Co. mill.

PARK COUNTY

Buckskin district.—The Buckskin Joe Mines, Ltd., operated the Phillips group of mines in Buckskin Gulch and the Alma-Betts 65-ton selective-flotation mill in Mosquito Gulch throughout 1944. The products of the mill were zinc, lead, and iron concentrates. The company also operated the Baxter mine under lease and treated the ore in the Alma-Betts mill. Miller & Logue continued to operate the Red Cross mine; 324 tons of zinc-lead ore containing 14 ounces of gold, 48 ounces of silver, 1,340 pounds of copper, 24,825 pounds of lead, and 46,091 pounds of zinc were shipped to the Golden Cycle mill at Colorado Springs for concentration.

Consolidated Montgomery district.—The Magnolia Gold Mining Co. operated the Lee Goss lode from January through October; crude milling ore was shipped to the Golden Cycle plant for concentration, and several shipments of dry gold ore were made to the Leadville smelter.

Mosquito district.—The London Extension Mining Co. worked the Orphan Boy mine throughout most of 1944, and shipments of zinc-lead ore were made to the Golden Cycle mill. Dump material from the North London mine was treated in the Record mill by Alma Mills, Inc.; 186 tons of concentrates produced were shipped to the Leadville smelter. A clean-up during the dismantling of the London mill yielded concentrates and bullion which were shipped to the Leadville smelter and the Denver Mint. A small production of bullion was reported from the Three Brothers claim.

Pulver district.—The Great Western mine on Wilkerson Pass 10 miles west of Lake George was operated from April through December by O. N. Sandholm; 1,354 tons of zinc ore containing 18 ounces of gold, 26,356 pounds of copper, 3,564 pounds of lead, and 176,403 pounds of zinc were shipped to the Golden Cycle mill.

PITKIN COUNTY

Roaring Fork district (Aspen).—The Midnight Mining Co. operated the Midnight mine and 50-ton selective-flotation mill on Richmond Hill continuously 6 days a week in 1944. The mine produced 8,303 tons of silver-lead-zinc ore averaging 15.1 ounces of silver to the ton, 3.7 percent lead, and 4.5 percent zinc. Lead and zinc concentrates were shipped to the Leadville and Amarillo (Tex.) smelters. Herron Bros. operated its 150-ton gravity-concentration mill north of Aspen throughout most of the year on dump material from the Henry Clay mine; bulk concentrates produced were shipped to the Golden Cycle mill for further treatment. Development at the Mountain Ranger group of claims recovered 2 tons of lead ore, which were shipped to the Leadville smelter. Lime fluxing material, carrying silver and lead, was shipped to the Leadville smelter from the Aspen Leases during the first part of the year.

RIO GRANDE COUNTY

Summitville district.—The Gold Links Mining Co. (under special grant from the War Production Board) operated the Little Annie Group of mines and 50-ton amalgamation and concentration-flotation mill the entire year. The mine produced 1,769 tons of ore averaging 1.2 ounces of gold and 0.65 ounce of silver to the ton and 0.45 percent copper; copper concentrates produced were shipped to smelters in Utah and California and in Leadville, Colo. Regular shipments of amalgamation bullion were made to the Denver Mint. The Jasper Mining Co. made one small shipment of dry gold ore from the Guadalupe and Miser Tunnel claims to the Leadville smelter.

ROUTT COUNTY

Milbank Franz continued to work the Greenville mine in the Hahns Peak area during 1944; 916 tons of zinc ore containing 6 ounces of gold, 1,010 ounces of silver, 10,284 pounds of copper, 22,439 pounds of lead, and 217,138 pounds of zinc were shipped to the Midvale (Utah) custom concentrator.

SAGUACHE COUNTY

Kerber Creek district (Bonanza).—Brugger & Keserich operated the Bonanza dump from January through August and made regular shipments to the Golden Cycle mill and the Midvale (Utah) custom concentrator. Other properties that shipped ore to the Golden Cycle mill during 1944 included the Cora, Erie, and Rawley mines. The Pratt-Bonanza Mining & Milling Co. operated the St. Louis mine under lease throughout the year and shipped 622 tons of zinc-lead ore to the Combined Metals Reduction Co. custom mill at Bauer, Utah. Several shipments of lead ore were made to the Leadville smelter. Some production from the Erie, Bonanza dump, Rawley, and St. Louis properties also was shipped to the Midvale (Utah) custom concentrator.

SAN JUAN COUNTY

Animas district.—The Shenandoah-Dives mine continued in 1944 to be the chief producer of metals in San Juan County. The company 700-ton selective-flotation mill on the Animas River near Silver-

ten treated 142,635 tons of ore from the Shenandoah-Dives consolidated group of claims on King Solomon Mountain. The lead and zinc concentrates produced were shipped to the Leadville and Amarillo (Tex.) smelters and contained 25,929 ounces of gold, 130,855 ounces of silver, 321,166 pounds of copper, 2,347,860 pounds of lead, and 634,887 pounds of zinc. Custom ore milled at the company mill during 1944 came from six mines in the Animas, Eureka, and Ice Lake Basin districts. The Highland Mary Mines, Inc., operated its group of mines and flotation mill in Cunningham Gulch from June through December. During the year the operators added a new ball mill and classifier to the mill, enlarging the daily capacity of the plant from 70 to 100 tons. A total of 5,762 tons of ore, averaging 0.22 ounce of gold and 4.10 ounces of silver to the ton, 0.10 percent copper, and 0.84 percent lead, was milled. Concentrates from this property were shipped to the Leadville smelter. The Denver Equipment Co. continued to operate the 100-ton Pride of the West selective-flotation mill at Howardsville on company ore from the Pride of the West group. The ore milled totaled 24,348 tons and averaged 0.061 ounce of gold and 3.76 ounces of silver to the ton, 0.21 percent copper, 5.10 percent lead, and 1.25 percent zinc. Other mines that operated in the Animas district in 1944 and shipped ore either to the Shenandoah-Dives mill or to the Golden Cycle mill at Colorado Springs were the Lark, Mogul, Little Fannie, and Kittimac.

Eureka district.—All the ore produced at mines in the Eureka district in 1944 was sold either to the Shenandoah-Dives or Golden Cycle mill. The three producers, in order of output, were the Fore-some Mining Co. (Columbus mine), A. R. Walker (Mountain Queen mine), and Vaughn Jones (Lead Carbonate mine).

Ice Lake Basin district.—Esmeralda Lease operated the Bandora mine from July 3 to November 15; 202 tons of zinc-lead ore were shipped to the Shenandoah-Dives mill.

SAN MIGUEL COUNTY

Upper San Miguel district (Telluride).—Telluride Mines, Inc., continued to operate during 1944 its 550-ton amalgamation and gravity-and flotation-concentration mill at Pandora 2½ miles east of Telluride. During most of the year the company operated the mine only one shift per day because of lack of underground labor and of absenteeism. The ore milled came from the Smuggler Union, Cimarron, and Montana properties. Mine production was augmented by treating dump material from the Tom Boy mine. Lead concentrates produced were shipped to the Leadville and Midvale (Utah) smelters; zinc concentrates were shipped to the Amarillo (Tex.) and Great Falls (Mont.) smelters. Alta Mines, Inc., continued operations at its Alta-St. Louis group and 100-ton gravity- and flotation-concentration mill. Production was restricted, however, by an acute shortage of mine and mill labor. A small quantity of bullion recovered by amalgamation was shipped to the Denver Mint from the Allegheny mine.

The Sunshine Mining Co., as agent for the Metals Reserve Company, continued the development program at the Treasury tunnel (Red Mountain district, Ouray County), which was extended in 1943 to intersect the Black Bear vein beneath the old Black Bear workings in Ingram Basin on the Telluride side of Columbia Mountain. On

July 1, 1944, the Idarado Mining Co., owner of the Black Bear mine and Treasury tunnel, liquidated all financial advances made by the Metals Reserve Company and assumed complete control of its property. Rehabilitation of the 250-ton selective-flotation mill at the portal of the tunnel was in progress the latter part of the year. The surface plant and mill are in Ouray County, but mining is in San Miguel County.

SUMMIT COUNTY

Breckenridge district.—The largest operation in the Breckenridge district in 1944 was the Lilly & Moran lease on the Sally Barber mine; 1,502 tons of zinc-lead ore were shipped to a smelter and custom mill in Utah. The Garvie London Gold Mining Co. continued to develop the Country Boy mine; crude zinc ore was milled at the Resurrection Mining Co. mill in Leadville and the Golden Cycle mill at Colorado Springs. A lessee on the Jumbo claim recovered a small amount of amalgam bullion and made several shipments of dry gold ore to the Leadville smelter. Horn Bros. operated the Minnie B mine from June through October and shipped 57 tons of dry gold-silver ore containing 16 ounces of gold, 1,882 ounces of silver, and 983 pounds of lead to the Leadville smelter.

Green Mountain district.—Walter McDaniel continued producing zinc ore from his Big Four mine on Green Mountain 17 miles south of Kremmling.

Montezuma district.—The Florado Mining Co. operated the Pinnacle claim and its 100-ton flotation mill 6 months during 1944 and shipped lead concentrates to the Leadville smelter. The Rogers Mines, Inc., worked the Morgan group of claims from January through April and shipped zinc-lead ore to the Golden Cycle mill at Colorado Springs. Properties in the Montezuma district from which zinc-lead ore was trucked to the Resurrection Mining Co. mill at Leadville were the New York, Ida Belle, and Rose. Twenty-nine tons of zinc-lead ore were shipped to the Midvale (Utah) custom mill from the Bell of California group. In addition to shipping 20 tons of zinc-lead ore to the Midvale (Utah) custom mill, Easter & Milner, operating the Silver Wing mine, made a small shipment of lead concentrates to the Leadville smelter. Lessees on the New York mine shipped dump material to the Leadville smelter and the Midvale (Utah) custom mill. Other properties in the Montezuma district reporting small production were the Empress and Erickson mines.

Ten Mile (Kokomo, Robinson) district.—The Wilfley Leasing Co. operated its Wilfley mine at Kokomo continuously in 1944 and shipped crude milling ore to the Resurrection Mining Co. custom mill at Leadville. The Wilfley 75-ton selective-flotation mill was not operated during the year. Control of the Washington and Hancock group (known as the Lucky Strike group) was acquired by the American Smelting & Refining Co. on February 28, 1944, under a purchase contract. Rehabilitation of the Cole-Peterson (Victory) tunnel to open the vein at greater depth was completed during the summer, and in September the company began regular shipments of crude milling ore to the Resurrection Mining Co. custom mill at Leadville. The Kokomo-Kimberly Mines, Inc., operated the Kimberly property throughout the year and shipped ore to the Golden Cycle mill at Colorado Springs. A. R. Rhine worked the Nettie B mine during the year and shipped zinc-lead ore to the Golden Cycle mill. A

lessee on the Golden Queen mine trucked 40 tons of dry silver ore to the Leadville smelter.

Wilkinson district.—Small production of lead ore was reported from the Tariff and Toledo claims.

TELLER COUNTY

CRIPPLE CREEK DISTRICT

The Cripple Creek district yielded 28 percent of the total gold production of the State in 1944. From 1891, when gold was discovered in the area, through 1944 it has yielded a total of 18,496,735 fine ounces valued at \$400,960,207, or 48 percent of the State total output of gold from 1858 to 1944, inclusive. In 1944 the district produced 30,886 ounces compared with 45,105 ounces in 1943, 104,455 in 1942, and 133,470 in 1941. The steady decline in production of gold since 1941 largely reflects the effect of the Gold Mining Limitation Order of October 1942 on the mining industry of the Cripple Creek district. The total production of ore from Cripple Creek mines and dumps in 1944 was 113,565 tons, all treated in the Golden Cycle mill (operations reviewed under El Paso County).

MINES REVIEW

Operations of the Golden Cycle Corp., which owns and operates the Golden Cycle mill at Colorado Springs and several mines in the Cripple Creek district, are described in the following extract from its annual report to stockholders for the year ended December 31, 1944 (dated May 7, 1945):

Stockholders were fully informed in the 1943 report relative to Order L-208 and its effect upon our activities. The Golden Cycle Corporation operated during 1944 under a special grant from the War Production Board, but because of the drastic shortage of labor, miners, and materials all of our operations were handicapped and drastically curtailed.

Production of strategic metals.—(1) During 1944 a total of 107,561 tons of complex ore with a gross value of \$1,060,097.81 was purchased from shippers for the production of lead-zinc concentrates. It is significant to note that complex ore purchased during this 12 months period contained the following metals: 21,544,583 pounds of zinc; 8,145,880 pounds of lead; 655,309 pounds of copper; 491,325 ounces of silver; and 6,166 ounces of gold; gross value \$1,060,097.81.

(2) During 1944, 16,113 tons of zinc concentrates were shipped to smelters of the American Zinc Co. located at Dumas, Tex., and Carondelet, Ill.; and 5,430 tons of lead concentrates were shipped to the American Smelting & Refining Co., Leadville, Colo.

(3) Zinc-lead ore for treatment at the Golden Cycle mill at Colorado Springs was received during the year from zinc-lead mines located in and near Leadville, Montezuma, Kokomo, the Bonanza district, Alma, Clear Creek County, San Juan County, and other mineralized areas of Colorado.

(4) The Golden Cycle Corporation did not engage on its own account during the year in the mining of zinc-lead ore. During 1944 the Golden Cycle Corporation purchased the Wilson group of mining claims, located in the Kokomo mining district near Leadville, Colo. Total acreage of these claims is 114. At present a portion of the Wilson property is under lease to the American Smelting & Refining Co.

(5) It is probable that during 1945 the Golden Cycle Corporation will again engage on its own account in the mining of zinc-lead ores. The War Production Board has informed us that at present lead is the most critical of all strategic metals, and, if possible, the Golden Cycle Corporation will do everything in its power to aid in the production of lead so vitally needed for the war at the present time.

Gold-mining operations. *Ajax, Anchoria Leland, Index, and Cameron mines.*—Gold-mining operations in the Cripple Creek mining district were greatly cur-

tailed during 1944. This was due not only to the fact that the number of company men and lessees dropped to the lowest figure in all our history, but also difficulties in obtaining sufficient materials and supplies. No betterment in gold production from the Cripple Creek district can be expected until an adequate supply of labor is secured. This depends upon the cessation of war hostilities first against Germany, and second, against Japan.

Only the Ajax and Anchoria Leland shafts were operated during the year. The Index and Cameron shafts were shut down.

Ajax operation.—Every effort was made to do as much development work as the limited number of men would allow. 4,940 feet of drifts, crosscuts, and raises were driven during the year. Most of the drifting was done on the Bob Tail vein system on the 26th, 27th, and 28th levels of the mine. Development work in this section was satisfactory and a number of ore chutes opened on each of these levels. A majority of the ore shipped during the year came from this development work. Very little stoping was carried on. A small amount of work was done west of the shaft on the New Market system on the 24th, 26th, and 27th levels with some ore being opened in this section of the mine. There still remains a large amount of territory on the deeper levels to be explored when the labor situation permits.

During 1944, 27,417 tons of company ore were shipped with a gross value of \$403,604 and 7,215 tons of lessee ore with a gross value of \$105,754, making a total of 34,632 tons with a gross value of \$509,358.

Anchoria Leland.—All development work on the Anchoria Leland was done by lessees. 1,006 feet of drifts, crosscuts, and raises were driven during the year. Total production was 3,305 tons with a gross value of \$26,201.

Index.—No work was done on the Index during the year. A small amount of dump ore was shipped to the mill.

Cameron.—During 1944 the Cameron gold-mining property was acquired by the Golden Cycle Corporation. It contains approximately 140 acres. No work was done by the company during the year.

Summary of gold-mining operations.—Mining operations on the properties of the Golden Cycle Corporation in the Cripple Creek mining district during 1944 produced a total of 38,181 tons of ore with a gross value of \$536,812.05. Net returns to the corporation from its properties after payment of freight and treatment but before payment of mining costs totaled \$314,324.88.

Carlton drainage tunnel.—During the year wooden timbering in the Carlton drainage tunnel was replaced with steel and the tunnel is now in good shape. It will be necessary to do some additional repair work on the track and water ditch. No serious trouble from loose ground in the near future is anticipated, as the tunnel, generally speaking, is in good shape throughout. The water flow from the Carlton drainage tunnel remains steady at approximately 4,800 gallons per minute. Practically all production from the Ajax and Portland mines during the year came from the area newly drained by the Carlton drainage tunnel. Without this drainage neither property would be operating today.

It is still impossible to forecast with any certainty the future of our corporation during the war period. Stockholders are assured that every effort will be made to continue our activities in connection with producing war necessities, and that every effort will be made to conserve properties and assets of the corporation for the stockholders' best interests, with the hope that with the end of the war operations can again be resumed upon a normal basis.

The annual report of the United Gold Mines Co., an operating and holding company for property scattered throughout the Cripple Creek district, for the year ended December 31, 1944 (dated March 15, 1945), gives the following details on operations at individual mines:

Operating loss for 1944 was \$16,792 vs. \$13,102 in 1943, an increase of \$3,690. This loss was caused by the same factors which operated adversely in 1943; to wit: damage done to the gold-mining industry in the United States and Alaska by Order L-208 entered October 8, 1942, by the Mining Branch of the War Production Board closing the gold mines. While extensions to operate upon a limited basis were subsequently granted the United Gold Mines Co.—due to the fact that practically all able-bodied men in the Cripple Creek mining district had either entered our armed forces or left the district to take higher paying defense jobs, coupled with the difficulty in securing necessary mining supplies, a situation was created which the company could not combat.

It is impossible at this date to make any intelligent forecast for this year. Resumption of gold mining upon a normal basis now depends upon the duration

of the war and when we can secure an adequate supply of labor and materials. It was hoped during the latter part of 1944 that the war with Germany would be over by January 1, 1945, but this did not materialize, and labor and materials have become even more critical than in 1944.

A résumé of our operations for 1944 follows:

Production from the United Gold Mines Co. reached a new low for the year 1944, both in tonnage and value. 67,885 tons were shipped with a gross value of \$478,455 and an average value of \$7.05 per ton. This included 24,048 tons shipped from the Theresa dump, with a gross value of \$75,896 and an average value per ton of \$3.16. Only 43,837 tons were shipped from the various other properties of the United Gold Mines Co. The number of lessees operating on the Portland, Vindicator, and Rose Nicol shafts has fallen to 16, the lowest number in the history of the company.

Portland operation.—Production from the Portland shafts amounted to 10,635 tons with a gross value of \$163,927, of which amount lessees shipped 3,372 tons with a gross value of \$82,088. The company ore came almost entirely from old caved stopes on the 27th, 29th, and 30th levels. 1,889 feet of drifts, crosscuts, and raises were driven by the lessees and company.

Vindicator operation.—Company and lessees shipped 16,708 tons with a gross value of \$111,343. 11,733 tons were shipped by lessees, and 4,974 tons by the company. 2,415 feet of drifts, crosscuts, and raises were driven by the company and lessees during the year.

The main shaft on the Vindicator hoist broke in August but the break was in such a position that hoisting could be carried on on one side. Efforts have been made since that time to obtain a new shaft, but without results to date. A new shaft will have to be placed in the hoist before full-scale operations can be carried on.

Rose Nicol operation.—Operations were carried on at the Rose Nicol shaft on a greatly reduced scale, as were our other properties. 2,104 tons with a gross value of \$23,418 were produced, only 70 tons of which was company ore. 796 feet of drifts, crosscuts, and raises were driven by the company and lessees during the year.

Very little work was done on the various other properties of the United Gold Mines Co. during the year. Some work was done on the Wild Horse and Patti Rosa shafts by lessees.

As pointed out above, no betterment in our situation can be expected until the war ends. The labor situation is daily growing worse. There are of course no young men working in the district today.

Production of company ore by United Gold Mines Co. in 1944

Mine	Net tons	Gross value ¹	Company ore cash receipts	Average gross value per ton ¹
Vindicator.....	1,507	\$7,129	\$2,584	\$4.73
Rose Nicol.....	70	850	502	12.08
Portland.....	7,263	81,839	48,522	11.27
Theresa-Cycle Dump.....	24,048	75,896	5,591	3.16
No. 2 Plant.....	3,467	14,049	3,976	4.05
	36,355	179,763	61,175	4.94

¹ Gross value calculated at settlement value.

Production of lessee ore of United Gold Mines Co. in 1944

Group	Net tons	Gross value ¹	Royalties received	Lessees' receipts	Average gross value per ton ¹
Vindicator.....	11,733	\$90,164	\$22,946	\$25,239	\$7.68
Rose Nicol.....	2,034	22,568	5,337	8,278	11.09
Portland.....	3,372	82,089	31,021	30,403	24.34
Butt Hill Group.....	14,391	103,871	5,453	46,567	7.22
	31,530	298,692	64,757	110,487	9.47

¹ Settlement value.

Production of properties of United Gold Mines Co. before and after organization of the company (May 15, 1902) to December 31, 1944

	Net tons	Gross value ¹
Ore mined before consolidation	26, 310	\$456, 806
Production under operation of United Gold Mines Co.	2, 536, 310	25, 562, 851
Total to Dec. 31, 1944	2, 562, 620	26, 019, 657

¹ Settlement value.

The annual report of the Cresson Consolidated Gold Mining & Milling Co. for the 12 months ended December 31, 1944 (dated February 1, 1945), says—

PRESIDENT'S REPORT

As set out in our 1943 annual report, due to the impossibility of securing labor because practically all able-bodied men had left the Cripple Creek district either to enter the armed forces or to take higher-paid defense jobs, plus our inability to secure necessary mining supplies, the Cresson mine was shut down and still remains idle in a standby condition.

Some revenue was derived during the year from war contracts. Considerable work was done during the year retimbering the shaft and preserving the property.

The latter part of 1944 it appeared the German war might be over by January 1, 1945, and we hoped the cessation of hostilities would ease our manpower, miner, and material shortages. However, as stockholders know, more drastic war demands for labor and material have created additional complications for the gold-mining industry. It is impossible at this time to state when the mine can be reopened, since the resumption of mining depends entirely upon securing adequate labor, miners, material, and equipment.

The management will continue to use every effort during this standby period to preserve the company's current financial position and maintain the properties for stockholders' best interests.

Production of Cresson Consolidated Gold Mining & Milling Co., 1903 to December 31, 1944

Period	Dry short tons	Gross value ¹	Freight and treatment	Net value
1903 to Dec. 31, 1943	3, 214, 394	\$46, 401, 708	\$15, 329, 206	\$31, 072, 502
1944:				
Company ore				
Lessee ore	2, 342	41, 337	13, 573	27, 764
1903 to Dec. 31, 1944	3, 216, 736	46, 443, 045	15, 342, 779	31, 100, 266

Period	Royalties received by company	Amount paid lessees	Average gross value per ton	Average net value per ton	Dividends
1903 to Dec. 31, 1943			\$14. 44	\$9. 67	\$13, 564, 673
1944:					
Company ore					
Lessee ore	\$4, 754	\$23, 010	17. 65	11. 85	
1903 to Dec. 31, 1944			14. 44	9. 67	\$13, 564, 673

¹ Settlement value.

² Represents 29.21 percent of gross value and 43.62 percent of net value.

Shipments from the Stratton Estate properties in 1944 totaled 3,660 tons of ore produced by lessees on the Logan, War Eagle, and Proper mines and the Logan, Los Angeles, and Jenkins dumps. Other producing mines and dumps in the Cripple Creek district in 1944 included the Acacia, Empire Lee, Forest Queen, Free Coinage, Gold Bond, Joe Dandy, Mary McKinney, Molly Kathleen, New Gold Dollar, Ocabams, and Mountain Monarch.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN STATES

(MINE REPORT)

By A. J. MARTIN

SUMMARY OUTLINE

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SUMMARY

The dominating factors in the mine production of gold, silver, copper, lead, and zinc in the Eastern States in 1944 were the shortage of labor supply and the outstanding importance of the metals and other products of the ores to the prosecution of the war. The only output of gold and silver was that recovered as a byproduct from base-metal ores and the 5 ounces of gold produced at placer mines. Most of the copper output continued to come from ores mined chiefly for their iron or their iron, sulfur (recovered as sulfuric acid), and copper content, but considerable copper was derived from straight copper ore and a little from zinc-lead ore; the production from all sources increased 6 percent over 1943. The output of lead—all from zinc-lead ore—increased 29 percent. The combined tonnage of zinc and zinc-lead ores mined decreased 2 percent from 1943; and the total production of zinc, including some from copper-iron-zinc ore, decreased 11 percent. War-essential byproducts derived from zinc and zinc-lead ores included sulfuric acid and cadmium. Variations from 1943 in zinc production in the several States were decreases of 14 percent in New Jersey, 23 percent in New York, and 2 percent in Tennessee and an increase of 6 percent in Virginia. Some of the large zinc and zinc-lead mines continued to operate without receiving the Government premium for any part of their output, and only 7 percent of the total "mine" value of the zinc concentrates (calculated for all concentrates upon the basis of the average grade and value reported for New York, Tennessee, and Virginia concentrates) represented premiums for overquota production. The ability of the zinc mines in the Eastern States to continue to produce zinc at comparatively low cost under war conditions indicates that their importance as a dependable domestic source of zinc will be enhanced in the postwar period. The lead output in 1944 came from New York and Virginia; the quantity produced in New York declined sharply, along with the decline in

zinc production, and that produced in Virginia increased materially. Copper output increased in Tennessee, Vermont, and Virginia and decreased in Pennsylvania and North Carolina. In North Carolina the Fontana and Hazel Creek copper mines were closed in January and October, respectively, and the State had no output of copper in November and December. War-inspired activity in prospecting and new development diminished as reserve stocks of copper and zinc were built up. The Bureau of Mines and Geological Survey continued to investigate sources of strategic and critical minerals; the work done on copper, lead, and zinc included exploratory diamond drilling and geophysical surveys in certain areas, scattered field examinations, and tests of ore-treatment methods.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported, except that of zinc in New Jersey, has been calculated at the prices in the following table. The value of the New Jersey output is the total value of the zinc recoverable as metal and oxide after freight, haulage, smelting, and manufacturing charges are added.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ⁴	Zinc ⁵
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940.....	\$35.00	\$0.711+	\$0.113	\$0.050	\$0.063
1941.....	35.00	4.711+	.118	.057	.076
1942.....	35.00	4.711+	.121	.067	.093
1943.....	35.00	4.711+	.130	.075	.108
1944.....	35.00	4.711+	.135	.080	.114

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price includes bonus payments by Metals Reserve Co. for overquota production.

⁴ \$0.7111111.

Annual figures for the 5 years ended with 1944 are given in the table that follows. The figures for tonnage of ore sold or treated do not include magnetite ore containing pyrite and chalcopyrite, from which copper, gold, and silver were recovered as byproducts.

Mine production of gold, silver, copper, lead, and zinc in the Eastern States, 1940-44, in terms of recovered metals

Year	Mines producing		Ore sold or treated (short tons) ¹	Gold (lode and placer) ²		Silver (lode and placer) ³	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1940.....	40	18	3,674,815	18,456	\$645,960	102,825	\$73,120
1941.....	43	14	3,780,397	21,982	769,370	106,051	75,414
1942.....	36	17	4,130,226	14,699	514,465	105,307	74,885
1943.....	29	3	4,211,961	2,878	100,730	128,129	91,114
1944.....	26	2	4,202,461	2,595	90,825	124,006	88,182

¹ Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.

² Includes placer gold as follows: 1940, 452 ounces; 1941, 203 ounces; 1942, 69 ounces; 1943, 12 ounces; 1944, 5 ounces.

³ Placer silver did not exceed 30 ounces in any year during the 3-year period ended with 1942, and none was produced in 1943 and 1944.

Mine production of gold, silver, copper, lead, and zinc in the Eastern States, 1940-44, in terms of recovered metals—Continued

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
1940.....	25,490,000	\$2,880,370	4,831	\$483,100	178,815	\$24,135,445	\$28,217,995
1941.....	27,132,000	3,201,576	5,513	628,482	191,310	29,484,423	34,159,265
1942.....	28,404,000	3,436,884	4,475	599,650	199,809	36,190,180	40,816,064
1943.....	28,490,000	3,703,700	4,843	726,450	199,233	39,225,222	43,847,216
1944.....	30,068,000	4,063,230	6,266	1,002,560	176,327	35,977,536	41,222,333

Gold.—Most of the gold produced from mines in the Eastern States in 1944 was recovered as a byproduct from magnetite-pyrite-chalcopryrite ore from the Cornwall mine in Lebanon County, Pa.; the gold from this mine was contained in copper concentrates shipped to the Phelps Dodge smelting and electrolytic-refining plant at Laurel Hill, N. Y. A little gold was recovered from copper-iron ore from the Tennessee Copper Co. mines in Polk County, Tenn., and the Fontana mine in Swain County, N. C.; from copper ore from the Elizabeth mine in Orange County, Vt., and the Hazel Creek mine near Proctor, N. C.; and from zinc-lead ore from the Valzinco mine in Spotsylvania County, Va. About 5 ounces of gold were recovered from placer mines near Dahlonega, Ga. The estimated output of gold in the Southern Appalachian States from 1799 to 1944 is recorded as follows:

Mine production of gold in the Southern Appalachian States, 1799-1944

State	Period	Fine ounces	Value	State	Period	Fine ounces	Value
Alabama.....	1830-1944	49,489	\$1,198,775	South Carolina..	1829-1944	318,801	\$7,562,125
Georgia.....	1830-1944	870,526	18,064,257	Tennessee.....	1831-1944	20,722	472,900
Maryland.....	(1) -1944	6,102	163,940	Virginia.....	1828-1944	167,546	3,577,089
North Carolina..	1799-1944	1,164,588	24,327,843	Total.....	1799-1944	2,597,774	55,386,929

¹ Year of first production not recorded.

Silver.—The mine output of silver in the Eastern States in 1944 comprised 67,192 ounces recovered from copper and copper-iron ore from North Carolina, Tennessee, Vermont, and Virginia; 43,269 ounces from zinc-lead ore from New York and Virginia; and 13,545 ounces from magnetite-pyrite-chalcopryrite ore from Pennsylvania.

Copper.—Mine production of copper in the Eastern States was maintained at a slightly higher average monthly rate in 1944 than in 1943. The Fontana copper mine in Swain County, N. C., a steady producer since 1926, was closed January 31, 1944, but the loss in output from this mine was more than offset by steady production throughout the year from the old Elizabeth mine of the Vermont Copper Co. at South Strafford, Vt., which was reopened in September 1943; also, the old Toncrae copper mine in Floyd County, Va., was reopened in 1944 and shipped 1,926 tons of crude ore averaging about 7 percent copper. The Hazel Creek copper-[zinc] mine near Proctor, Swain County, N. C., was operated on a small scale from January through October and then closed, as the property was taken over

by the Tennessee Valley Authority for park purposes. Copper output from the Tennessee Copper Co. mines in Polk County, Tenn., principal producer in the Eastern States, was a little larger than in 1943; but that from the Cornwall iron (magnetite-pyrite-chalcopyrite) mine in Lebanon County, Pa., second-largest producer, decreased. In the following table by States the combined output of North Carolina, Pennsylvania, and Tennessee is shown under Tennessee to avoid disclosing output of individual mines.

Lead.—The mine output of lead in the Eastern States in 1944 was derived from zinc-iron-lead sulfide ore from the Balmat mine in New York and zinc-lead sulfide ore from the Austinville and Valzinco mines in Virginia; the quantity produced was 6,266 tons compared with 4,843 tons in 1943. The output in 1943 included 200 tons from Tennessee, most of which was recovered from lead carbonate ore from the Embree mine.

Zinc.—The mine output of 176,327 tons of zinc in 1944 was the lowest for the Eastern States in any year since 1938 and compares with 199,233 tons in 1943. The ore reserves were reported ample to maintain a production rate comparable with that in 1943 had sufficient manpower been available. In some of the large mines fully equipped headings in good ore were worked only part time owing to labor shortage. Large-scale mechanized operation of a recently developed open-pit mine in Tennessee prevented a material decline in output in that State. Zinc production in New Jersey decreased from 92,864 tons in 1943 to 80,288 tons in 1944, that in New York from 46,000 to 35,541 tons, and that in Tennessee from 41,766 to 40,831 tons; production in Virginia increased from 18,603 to 19,667 tons. The principal producing mines in all four States were the same as in 1943, but a few small producers that were active in 1943 did not operate in 1944. The Valzinco zinc-lead mine in Spotsylvania County, Va., which was reopened in 1942 and operated throughout 1943 and 1944, was closed in January 1945.

MINE PRODUCTION BY STATES

Mine production of gold, silver, copper, lead, and zinc in the Eastern States in 1944, by States, in terms of recovered metals

State	Mines producing		Ore (short tons)	Gold		Silver (all lode)	
				Fine ounces		Fine ounces	Total value
	Lode	Placer		Lode	Placer		
Georgia.....		2			5		\$175
New Jersey.....	2		543,007				
New York.....	3		423,557			25,238	\$17,947
North Carolina.....	3		6,438	21		1,461	1,039
Pennsylvania.....	1		(1)	2,115		74,025	9,632
Tennessee.....	13		2,607,556	222		45,907	32,645
Vermont.....	1		91,289	100		18,862	13,413
Virginia.....	3		530,614	132		18,993	13,506
	26	2	4,202,461	2,590	5	124,006	88,182
Total, 1943 ¹	20	3	4,211,961	2,866	12	128,129	91,114

¹ Ore is magnetite-pyrite-chalcopyrite, flotation copper concentrates from which yielded gold, silver, and copper. Bureau of Mines not at liberty to publish figures for ore and copper.

² Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.

³ Includes output from South Carolina, as follows: 1 lode mine; ore treated, 156 tons; gold produced, 147 ounces, value, \$8,145; silver, 135 ounces, \$96; copper, 1,000 pounds, \$130; total value, \$5,371.

Mine production of gold, silver, copper, lead, and zinc in the Eastern States in 1944, by States, in terms of recovered metals—Continued

State	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
Georgia							\$175
New Jersey					80, 288	\$14, 080, 644	\$ 14, 080, 644
New York			1, 644	\$263, 040	35, 541	8, 103, 348	\$ 8, 394, 335
North Carolina	(9)	(9)					\$ 1, 774
Pennsylvania	(9)	(9)					\$ 83, 657
Tennessee	25, 720, 000	\$3, 472, 200			40, 831	9, 309, 468	\$ 12, 822, 083
Virginia	3, 796, 000	512, 460					529, 373
West Virginia	582, 000	78, 570	4, 622	739, 520	19, 667	4, 484, 076	5, 320, 292
Total, 1944	30, 098, 000	4, 063, 230	6, 266	1, 002, 560	176, 327	35, 977, 536	41, 222, 333
	28, 490, 000	3, 703, 700	4, 843	726, 450	199, 233	39, 225, 222	43, 847, 216

See footnote preceding page.

* Estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.

† North Carolina and Pennsylvania included under Tennessee; Bureau of Mines not at liberty to publish these figures.

‡ Includes value of copper, which is included under Tennessee.

§ Includes also value of copper from North Carolina and Pennsylvania.

MINING INDUSTRY

Although no new war projects for expanding mine production of copper, lead, and zinc were undertaken in the Eastern States during 1944, emphasis continued on the need for maintaining maximum output from established operations consistent with proper utilization of the limited manpower available for war-essential industries. The sharp decline in lead stocks in the latter part of the year caused the War Production Board to request operators of lead mines to increase production, but this action did not materially affect mining in the Eastern States, as the bulk of the lead output in recent years has come from mines producing mostly zinc. Little manpower was available for underground development other than that required to extract currently mined ore. In Tennessee a fully mechanized open-pit mine, developed and equipped in 1943 and operated at a high rate throughout 1944, aided in maintaining zinc production. Diamond and churn drilling on extensions of ore bodies continued at approximately normal rates at most of the base-metal mines. The Bureau of Mines made geophysical surveys in the copper district in Orange County, Va., and the zinc-lead area at Paytes, Va., and did exploratory drilling on zinc-lead properties at Warren, N. H., and Paytes, Va., and on zinc properties in the Friedensville district in Pennsylvania and the New Hazewell-Powell River, Embreeville, and Eve's Mill areas in Tennessee. The wartime shut-down of the gold mines continued throughout 1944. The quantity of the various types of ore mined in the Eastern States is shown in the table that follows.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in the Eastern States in 1944, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (short tons)	Zinc (short tons)
Copper ore.....	1, 132, 178	343	67, 192	129, 784, 000	-----	(¹)
Magnetite-pyrite-chalcopyrite ore.....	(²)	2, 115	13, 545	(¹)	-----	-----
Zinc ore.....	2, 238, 144	-----	-----	-----	-----	128, 822
Zinc-lead ore.....	832, 139	132	43, 269	314, 000	6, 266	46, 505
Total, lode mines.....	4, 202, 461	2, 590	124, 006	30, 098, 000	6, 266	176, 327
Total, placer.....	-----	5	-----	-----	-----	-----
	4, 202, 461	2, 595	124, 006	30, 098, 000	6, 266	176, 327
Total, 1943.....	4, 211, 961	2, 878	128, 129	28, 490, 000	4, 843	199, 233

¹ Copper from magnetite-pyrite-chalcopyrite ore included with that from copper ore.

² Zinc from copper ore included with that from zinc-lead ore; Bureau of Mines not at liberty to publish separate figures.

³ Bureau of Mines not at liberty to publish separate figures for ore and copper.

⁴ Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.

METALLURGIC INDUSTRY

No important changes were reported in metallurgical practice in copper, zinc, and zinc-lead ore-reduction mills in the Eastern States in 1944. The methods of treatment used and other operating details, including tonnage and grade of concentrates produced at some of the mills, are given in the Review by States that follows. Most of the concentrates are shipped to smelters operated by the companies that own the mines. No amalgamation or cyanidation mills were operated during the year. Five ounces of gold were recovered from placer mines by hand methods. Direct-smelting ore (142,473 tons) yielded 60 ounces of recoverable gold and 16,269 ounces of silver in 1944, and concentrates smelted (88,473 tons) yielded 2,530 ounces of gold and 107,737 ounces of silver; the figures for ore and concentrates do not include material containing no recoverable gold or silver. The total for direct-smelting ore was 143,622 tons and for concentrates (including low-grade concentrates shipped to oxide plants) 685,010 tons.

REVIEW BY STATES

GEORGIA

Individuals recovered 5 ounces of gold from scattered placer mines in Dawson and Lumpkin Counties in 1944. The gold was contained in small lots of retorts and grains sold to J. S. Speer, of Dahlonega, who combined the lots for shipment to the Philadelphia Mint.

NEW JERSEY

The output of crude zinc ore in New Jersey in 1944 was 543,007 tons yielding 80,288 tons of recoverable zinc as metal or in oxide compared with 602,646 and 92,864 tons, respectively, in 1943. The producing mines in both years were the Mine Hill at Franklin and the Sterling Hill at Ogdensburg, Sussex County. The commercial ore minerals comprise chiefly franklinite (a zinc-iron-manganese mineral) and willemite (zinc silicate) but also include zincite (red oxide of zinc). Each mine is equipped with a mill. In the reduction of the

ore the franklinite is removed from the crushed ore by magnetic separators, and the willemite and zincite are concentrated on jigs and tables. The concentrates are shipped to smelting and manufacturing plants at Palmerton, Pa. The franklinite is used in the manufacture of zinc oxide and spiegeleisen, and the willemite-zincite concentrate is smelted to produce high-grade slab zinc.

The value of the New Jersey output of zinc given in the table of this chapter under the heading Mine Production by States is the combined value of the zinc recoverable in both metal and oxide after freight, haulage, smelting, and manufacturing charges are added.

New Jersey has a few deposits of copper ore, but none has been worked for many years. Copper and lead smelters and refineries at Carteret and Perth Amboy treat ores, scrap, byproducts, and bullion from various States and foreign countries.

NEW YORK

New York has been a steady annual producer of zinc since 1915, of lead since 1930, and of silver since 1934. Lead and zinc were produced in some of the earlier years, and a little gold was reported recovered in experimental testing of black sands near Croghan, Lewis County, in 1909. No mine output of copper in the State has been recorded; the first complete mine canvass covered 1907. The silver, lead, and zinc are mined in a small area in St. Lawrence County east and southeast of Gouverneur. Most of the output in 1944, as in other recent years, was produced by the Balmat and Edwards mines of the St. Joseph Lead Co. In response to the need for expanding domestic mine output of zinc for war purposes, the company operated the mines at high production rates from 1941 to 1943, inclusive, and in 1943 New York ranked seventh among the States of the Union in zinc production. Operating rates averaged lower in 1944, and the State output of recoverable zinc dropped to 35,541 tons from 46,000 tons in 1943. The Balmat ore contains zinc, iron, and lead sulfides, and some silver is associated with the lead; it is mined through a 2,655-foot 40° inclined shaft (vertical depth, about 1,300 feet) and treated in the 1,200-ton selective flotation plant at the mine. The mill feed in 1944 totaled 303,451 tons; it yielded 2,776 tons of lead concentrates containing 60.46 percent lead and 11.7 ounces of silver to the ton, 49,322 tons of zinc concentrates containing 56.06 percent zinc, and 60,519 tons of pyrite concentrates containing 40.70 percent iron and 48.90 percent sulfur. The Edwards mine was operated through a vertical shaft 1,560 feet deep and an underground shaft (inclined 42° from horizontal) 1,226 feet to the mine workings. Ore treated totaled 101,739 tons yielding 18,005 tons of zinc concentrates containing 59.22 percent zinc. The zinc concentrates from both mills were shipped to the company smelter at Joseph-town, Pa.; the lead concentrates from the Balmat mill were shipped to the company Herculanum (Mo.) smelter. The pyrite concentrates were sold to sulfuric acid plants. The Universal Exploration Co. continued to operate its Hyatt mine and 200-ton flotation mill near Emeryville. The mine shaft is 450 feet deep. Development done in 1944 totaled 900 feet of drifts and 15,490 feet of diamond drilling. The concentrates were shipped to the Donora (Pa.) smelter.

There are no zinc or lead smelters in New York. The Phelps Dodge Refining Corporation has a custom copper smelter and an electrolytic

refinery at Laurel Hill which treat copper ore, matte, bullion, and copper-bearing scrap material.

NORTH CAROLINA

The only output of gold and silver in North Carolina in 1944 was that recovered as a byproduct of the mining of copper-iron and copper ores. The Condor (old Howie) mine near Waxhaw in Union County—principal producer of gold in the State in the years immediately preceding the wartime shut-down of the gold mines in 1942—was idle throughout 1943 and 1944. The State has produced no recoverable lead since 1938 and no zinc since 1913. The copper output in 1944 was much less than in 1943. The Fontana copper mine in Swain County, a steady producer since 1926, was closed January 31, 1944, and is not expected to reopen, as the proximity of the water level of the Fontana Dam on Little Tennessee River to the mine shaft will make it unsafe to operate the mine. The Hazel Creek copper-[zinc] mine and 25-ton flotation mill of the North Carolina Mining Co. near Proctor in Swain County were operated on a small scale from January through October and then closed, as the property was taken over by the Tennessee Valley Authority for park purposes. About 80 tons of 46-percent zinc concentrates containing some copper were produced in the mill but were re-treated to recover only the copper when the property was being cleaned up in preparation for abandonment. Seven tons of copper ore were shipped from the Bear Creek mines in Chatham County to the U. S. Metals Refining Co. smelter at Carteret, N. J.

PENNSYLVANIA

The Pennsylvania output of gold, silver, and copper was derived from magnetite-pyrite-chalcopyrite ore from the Cornwall mine of the Bethlehem Steel Co. in Lebanon County. The mine is developed by an open pit and three inclined shafts 1,700 feet deep. The ore is crushed to about 1-inch size at the shafts in Cornwall and shipped in standard hopper-bottom railroad cars to the combined magnetic concentration and flotation mill at Lebanon. The magnetic concentration equipment has a daily capacity of 6,500 tons and the flotation equipment 2,800 tons. Other equipment includes a 2,400-ton sintering plant which handles part of the magnetic concentrates; the rest is shipped to another plant at Bethlehem. The flotation equipment treats tailings from the magnetic separators for the recovery of copper concentrates, which contain most of the gold and silver, and pyrite concentrates, which contain cobalt. The copper concentrates are shipped to the Phelps Dodge smelter and electrolytic refinery at Laurel Hill, N. Y., and the pyrite concentrates to plants outside the State for recovery of sulfur (as sulfuric acid) and cobalt; the final pyrite residue is sintered and shipped to an iron and steel plant.

The zinc mines in Pennsylvania have been idle for many years. Exploratory drilling by the Bureau of Mines on the Correll zinc property in the Friedensville district, Lehigh County, was completed in January 1944. Zinc smelters at Donora, Langeloth, Josephstown, and Palmerton treat the largest part of the zinc concentrates produced in the Eastern States, as well as large tonnages from the

Central States and foreign countries. There is a roasting plant for concentrates at New Castle and an electrogalvanizing plant for sheets at Johnstown that uses roasted zinc concentrates.

SOUTH CAROLINA

Mines in South Carolina yielded no gold, silver, or copper in 1944; the output in 1943—all from the Terry mine near Smyrna, York County—was 147 fine ounces of gold, 135 fine ounces of silver, and 1,000 pounds of copper. The Haile mine in Lancaster County, equipped with a 400-ton cyanide mill, was the principal producer of gold in South Carolina and in the Eastern States in each year of the 3-year period ended in 1942. The mine will presumably remain closed until Gold Mining Limitation Order L-208 is canceled and conditions are again favorable for gold mining.

TENNESSEE

Production of recoverable zinc in Tennessee was 40,831 tons in 1944 compared with 41,766 tons in 1943 and the peak of 43,971 tons in 1942. The decreases in the past 2 years were caused by shortage of labor in the mines, as ore reserves and mill capacities were adequate for production equal to that in 1942. No lead was produced in the State in 1944 and only 200 tons in 1943. The output of gold, silver, and copper did not vary greatly from 1943. The gold and silver were recovered as byproducts from copper-iron-zinc ore from the mines of the Tennessee Copper Co. at Ducktown, Polk County. In 1944 the company continued to operate the Burra Burra, Eureka, Boyd, and Calloway mines and the London and Isabella flotation mills. The 1,200-foot Gordon shaft was reopened during the year, and the Mary mine was unwatered. The average depth of the four ore-hoisting shafts is about 1,500 feet. Development done in 1944 totaled 553 feet of shaft, 15,727 feet of drifts, and 39,061 feet of diamond drilling. The ore contains sulfides of iron, copper, and zinc. The iron concentrates produced in the mills are roasted to release the sulfur for use in making sulfuric acid in company plants at Isabella and Copperhill; the oxidized calcines from the roasters are sintered and sold to iron and steel producers. The zinc concentrates are shipped to the Donora (Pa.) smelter. The copper concentrates are smelted in a reverberatory furnace at the company Copperhill smelter without preliminary roasting. The smelter has two stand-by blast furnaces, one of which was operated on crude ore in 1944 to boost production of sulfuric acid. The matte from the reverberatory and blast furnaces was treated in a converter. A small tonnage of copper concentrates was treated directly in the converter for gas and temperature control. Most of the blister copper from the converter was cast into pigs and shipped to an electrolytic refinery on the Atlantic seaboard, where some gold and silver were recovered as byproducts. Shot copper was produced for use in the company copper sulfate plant at Copperhill.

The bulk of the zinc output of Tennessee in 1944 continued to come from the Mascot-New Market-Jefferson City district. The American Zinc, Lead & Smelting Co. operated the Mascot No. 2 mine in Knox County and the Grasselli, Shallow Ore, Jarnagin, and Mossy Creek

in Jefferson County. The Mascot is opened by a 520-foot shaft and an inclined shaft from the 520-foot level to the maximum depth of 850 feet; it also has an auxiliary manway shaft and a ventilating shaft. The Grasselli has one operating shaft and an auxiliary manway shaft and is 350 feet deep. The Jarnagin has one operating shaft 280 feet deep, with an auxiliary manway shaft. The Mossy Creek is opened by a 249-foot incline shaft. The Shallow Ore had one open pit 750 feet long, 500 feet wide, and 45 feet deep at the beginning of the year; stripping to open another pit was done during the year, and the first pit was worked to a depth of about 80 feet. All the mines are fully mechanized. Slushing is the principal method of underground loading, and power shovels, bulldozers, and 19-ton caterpillar trucks are used in loading and haulage in the open pits. Development done at the four underground mines in 1944 totaled 5,427 feet of drifts and raises, 32,462 feet of diamond drilling, and 21,101 feet of churn drilling. An additional 1,607 feet of churn drilling was done at the Shallow Ore mine. The crude ore from all five mines was treated in the company mill at the Mascot No. 2 mine. The ore from the four mines in Jefferson County was transported to the mill over the Southern Railway. The mill is equipped with a differential-density cone unit, jigs, and flotation machines and has a capacity of 4,000 tons daily. It treated 1,339,862 tons of crude ore in 1944, and its total output of zinc concentrates was 55,690 tons—a 6-percent increase over 1943. The increase was made possible by greatly expanding production from the Shallow Ore open-pit mine, as output from the underground mines was reduced by labor shortage. The annual company report to stockholders contains the following data on prospecting on optioned properties and ore reserves: Prospecting on outside properties in Knox County consisted of 3,565 feet of diamond drilling; in Jefferson County, 23,417 feet of diamond and churn drilling; and in Hamblen County, 3,000 feet of diamond drilling. Drilling results for the year were encouraging. A new mine was indicated on one property in Jefferson County. Drilling results on this property since the end of the year have materially extended indicated reserves, and if labor is available development preparatory to production will be started during the third quarter of 1945. Ore reserves at the end of 1944 on properties owned or under lease (not including any of the new ore indicated on properties under option or under management contract or the Shallow Ore mine) show an increase of approximately 2,000 tons of concentrates above the reserves at the end of 1943.

The Universal Exploration Co. group of mines and 800-ton flotation mill at Jefferson City were operated at less than capacity most of 1944 owing to inability to obtain enough workers to man the equipment at all working faces in the mine; consequently, the output of concentrates was less than in 1943. The average grade of the concentrates shipped in 1944 was 64.29 percent zinc. The mine is worked through two shafts 180 and 240 feet deep. Development done in 1944 totaled 300 feet of drifts, 27,961 feet of diamond drilling, and 11,030 feet of churn drilling. New incline and slusher hoists were installed underground. During the year the company began developing the Straight Creek mine in the New Tazewell area in Claiborne County. An old 800-foot tunnel was cleaned out and enlarged, surface build-

ings were constructed, and air compressors, incline hoists, slusher hoists, and pumps were installed. An electric power line was run to the mine. Sinking of an underground incline and other development were begun in December. The Lacy-Butler Co. shipped 54 tons of washed carbonate ore from the Cooper mine at Jefferson City to the American Agricultural Chemical Co. at Carteret, N. J. The Bunche's Hollow mine and 100-ton flotation mill of the Imperial Mining Co. near Goin, Claiborne County, were idle throughout 1944. The New Prospect mine at Lead Mine Bend, operated on a small scale in 1942 and 1943, was closed in January 1944. The Bureau of Mines did prospect diamond drilling on the Idol, Dalton, Stiner, and Tennessee Valley Authority properties in the New Tazewell-Powell River area and the Eve's Mill property in Monroe County. The Embree group of mines in Washington and Unicoi Counties made no output of zinc or lead in 1944. The exploratory diamond-drilling project of the Bureau of Mines on this property was suspended in January, but the Tennessee Zinc Co. did additional churn drilling during the year. The Hoover mine and small gravity-concentration mill in Cannon County east of Murfreesboro were operated intermittently, as the water supply for the mill was low during the summer.

VERMONT

The Vermont Copper Co. operated the Elizabeth mine and 500-ton flotation mill in Orange County throughout 1944. The mine was worked through a 1,200-foot adit, an underground 30° inclined shaft which was 925 feet long at the end of the year, and four main levels opening up the vein, which has a strike length of 1,000 feet. The ore minerals are chalcopyrite and pyrrhotite, carrying some silver and a little gold. The broken ore is hauled by underground tram to loading chutes on the adit at the top of the underground shaft and from there to the mill by an electric locomotive in Granby-type ore cars of 5-ton capacity. Ore milled in 1944 totaled 91,289 tons averaging 2.26 percent copper; it yielded 8,824 tons of concentrates containing 21.60 percent copper and 2.50 ounces of silver and 0.015 ounce of gold to the ton. The concentrates were shipped to the Phelps Dodge smelter at Laurel Hill, N. Y. The Bureau of Mines made a geophysical survey of the Orange County copper district during the year.

VIRGINIA

No gold mines were operated in Virginia in 1944, but some gold, silver, and copper were recovered from zinc-lead ore, and a little silver was derived from copper ore. The Toncræ copper mine in Floyd County was reopened by the Toncræ Mining Co. and began shipping ore to the U. S. Metals Refining Co. at Carteret, N. J., in April. The mine had been idle for many years and was among the properties drilled by the Bureau of Mines in its expanded exploratory program begun in 1942 to stimulate output of strategic and critical war minerals. Ore shipped in 1944 totaled 1,926 tons averaging about 7 percent copper; in addition, 2,100 tons of lower-grade ore was mined and stock-piled for treatment later by leaching. The output of recoverable lead in Virginia increased from 2,288 tons in 1943 to 4,622

tons in 1944, and zinc from 18,603 to 19,667 tons. The Austinville zinc-lead mine in Wythe County, which has produced the bulk of the Virginia output of zinc and lead since 1927, was operated continuously in 1944; the ore was treated in the 2,000-ton selective flotation mill at the mine. The output of both zinc and lead concentrates was larger than in 1943. The Valzinco zinc-lead mine and 100-ton flotation mill near Paytes in Spotsylvania County were operated throughout 1944 but were closed in January 1945. The mine was reopened in 1942 by Panaminas, Inc., subsidiary of Ventures, Ltd., and had been in production since September of that year. The mill products in 1944 were zinc concentrates and zinc-lead concentrates, both containing some gold, silver, and copper. The zinc concentrates were shipped to the Langeloth (Pa.) smelter and the zinc-lead concentrates to the International (Utah) lead smelter and slag-fuming plant. The drilling project of the Bureau of Mines on this property was completed in January, but experimental geophysical prospecting was done on this and other adjacent properties late in the year.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN IDAHO

(MINE REPORT)

By G. E. WOODWARD AND PAUL LUFF

SUMMARY OUTLINE

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SUMMARY

The total value of gold, silver, copper, lead, and zinc produced by Idaho mines was \$42,591,137 in 1944 compared with \$43,199,910 in 1943—a 1-percent decrease (see fig. 1). The value of the gold output was \$875,280 (2 percent of the State total), silver \$7,062,481 (nearly 17 percent), copper \$455,760 (1 percent), lead \$13,364,800 (31 percent), and zinc \$20,832,816 (49 percent). The quantity and value of each metal, except zinc, produced were less than in 1943. Compared with 1943, gold production decreased 19 percent, silver 15, copper 27, and lead 13 percent; zinc production increased 5 percent. In 1944 Idaho was the largest producer of silver, antimony, and tungsten in the United States and ranked second in lead and zinc; the output of zinc was the greatest in any year in the history of the State.

Production of copper, lead, and zinc in Idaho in 1944 was affected by the following factors: An acute shortage of labor, which was more serious than in 1943; the marked increase in output of zinc from the Bunker Hill & Sullivan zinc slag-fuming plant at Bradley and the Hecla zinc-lead tailing plant at Osburn; the large production of lead-silver ore from the Chester vein and the Silver Syndicate fault zone in the Coeur d'Alene region by the Sunshine Mining Co.; the notable decrease in output of silver, lead, and zinc from the Hecla mine at Burke, resulting from exhaustion of known commercial ore; the suspension (temporarily) in March of mining silver-copper-antimony ore from the Sunshine mine near Kellogg; and the marked decrease in output of silver-copper-antimony ore from the Mineral Point (Coeur d'Alene Mines Corp.) mine near Osburn.

Premium payments for overquota production of copper, lead, and zinc were in force throughout 1944. Considerable assistance was given to mine operators in Idaho in 1944 by the Grazing Service and Forest Service through the building of access roads to various properties. Most of the roads approved for construction were to zinc-lead and lead properties in Blaine, Butte, Camas, Clark, Lemhi, and Shoshone Counties. The Federal Bureau of Mines, in cooperation with the Federal Geological Survey, did much work in 1944 exploring and

testing various properties throughout the State. Most of this work was drilling test holes at the Blackbird cobalt-copper deposit in Lemhi County, the Pine Creek zinc-lead area of the Coeur d'Alene region, the mica-beryl deposits in Latah County, the Clark Fork lead-silver district in Bonner County, and the fluorspar deposits on Camas Creek near Meyers Cove in Lemhi County.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ³	Zinc ³
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940.....	\$35.00	\$0.711+	\$0.113	\$0.050	\$0.063
1941.....	35.00	0.711+	.118	.057	.075
1942.....	35.00	0.711+	.121	.067	.093
1943.....	35.00	0.711+	.130	.075	.108
1944.....	35.00	0.711+	.135	.080	.114

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was \$20.67+(\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price includes bonus payments by Metals Reserve Company for overquota production.

⁴ \$0.7111111.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1940-44, and total, 1863-1944, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1940.....	378	548	2,556,687	146,480	\$5,126,800	17,552,240	\$12,481,593
1941.....	331	524	2,704,686	149,816	5,243,560	16,672,410	11,855,936
1942.....	203	236	2,900,704	95,020	3,325,700	14,644,890	10,414,144
1943.....	127	30	2,741,747	30,808	1,078,280	11,700,180	8,320,128
1944.....	112	20	3,271,038	25,008	875,280	9,931,614	7,062,481
1863-1944.....	-----	-----	(¹)	7,779,994	175,439,193	505,851,641	347,996,840

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1940.....	6,698,000	\$756,874	209,668,000	\$10,483,400	141,202,000	\$8,895,726	\$37,744,393
1941.....	7,242,000	854,556	209,828,000	11,990,196	158,168,000	11,862,600	41,776,848
1942.....	6,860,000	830,060	227,818,000	15,263,806	174,512,000	16,229,610	46,063,326
1943.....	4,648,000	604,240	192,914,000	14,468,550	173,414,000	18,728,712	43,199,910
1944.....	3,376,000	455,760	167,060,000	13,364,800	182,744,000	20,832,816	42,591,137
1863-1944.....	² 105,201	32,202,807	² 5,811,950	631,028,218	² 1,138,702	174,584,427	1,361,251,485

¹ Figures not available.

² Short tons.

Gold and silver produced at placer mines in Idaho, 1940-44, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Drift mining		Dredges						Total	
					Dry-land ¹		Dragline floating ¹		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1940	6,664	1,337	291	48	5,623	758	6,569	5,427	41,262	10,226	60,409	17,796
1941	4,899	1,149	228	46	3,185	388	11,725	2,100	52,358	13,725	72,395	17,408
1942	1,197	234	83	7	563	60	6,126	879	36,611	9,291	44,580	10,471
1943	249	69	6	—	—	—	—	—	—	—	255	69
1944	118	31	18	—	—	—	—	—	—	—	136	31

¹ A floating washing plant supplied with gravel by a dragline excavator is called a "dragline floating dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

Gold.—The output of recoverable gold in Idaho was 25,008 fine ounces in 1944, the smallest output since 1931 and 19 percent less than in 1943. This decrease resulted principally from a marked decline in output of gold from the Boise-Rochester-Monarch (Talache Mines, Inc.) property at Atlanta, which had been the largest producer of gold in Idaho since 1940. The yield of gold from lode mines decreased from 50,553 ounces in 1943 to 24,872 ounces in 1944 and that from placers from 255 to 136 ounces. The output of gold from lode mines in 1942 was 50,440 ounces and that from placers 44,580 ounces. The output of gold from placers in 1944 was the smallest since 1862, the year before placer gold was first mined in the State. About 53 percent of the State total gold in 1944 came from siliceous gold ore, 43 percent from zinc-lead ore, and nearly all the remainder from lead ore, copper ore, silver ore, and placers. In 1944 more than 79 percent of the State gold output came from three lode mines—in the Yellow Pine, Warm Springs, and Middle Boise (Atlanta) districts.

The Bradley Mining Co., operating the Yellow Pine mine at Stibnite, was the largest gold producer in Idaho in 1944; it was followed, in order, by the Triumph mine near Ketchum and the Boise-Rochester-Monarch property at Atlanta.

Silver.—The output of recoverable silver in Idaho was 9,931,614 fine ounces in 1944—15 percent less than in 1943. The loss was attributed largely to suspension in March of the mining of silver-copper-antimony ore from the Sunshine vein by the Sunshine Mining Co.; however, a greater decrease was prevented through the large output of lead-silver ore made from the Chester vein and the Silver Syndicate fault zone near Kellogg by the Sunshine Mining Co. Large decreases in silver output were reported also by the Mineral Point, Bunker Hill & Sullivan, Hecla, Polaris, Morning, Triumph, Page, Tamarack, Yellow Pine, Gold Hunter, and Sherman properties. The Coeur d'Alene region produced 87 percent of the State total silver in 1944; the remainder came largely from the Warm Springs, Bayhorse, Yellow Pine, Deadwood Basin, Blue Wing, Clark Fork, and South Mountain districts. Of the State total silver, zinc-lead ore and old tailings yielded 43 percent, lead ore 32 percent, silver ore 22 percent, and gold ore, zinc ore, and zinc slag nearly all the remainder. The recovery of silver from silver ore decreased 2,379,088 ounces (mainly at the Sun-

shine and Mineral Point mines) and from zinc-lead ore 677,979 ounces, but that from lead ore increased 1,359,947 ounces owing to the yield from the Chester vein and the Silver Syndicate fault zone.

Ten mines—the Sunshine, Polaris, Bunker Hill & Sullivan, Triumph, Osborn tailing plant, Page, Silver Dollar, Morning, Mineral Point, and Silver Syndicate—produced 76 percent of the silver output of the State in 1944. All these except the Triumph are in the Coeur d'Alene region.

Copper.—The output of recoverable copper in Idaho in 1944 was 3,376,000 pounds—27 percent less than in 1943. The loss was due mainly to the decreased output of silver-copper-antimony ore from the Mineral Point and Sunshine mines in the Coeur d'Alene region. About 76 percent of the State copper output in 1944 came from zinc-lead ore, silver ore, and lead ore from mines in the Coeur d'Alene region; the remainder came largely from zinc-lead ore in the Warm Springs district, copper ore in the Alder Creek and Seven Devils districts, and zinc ore in the South Mountain district.

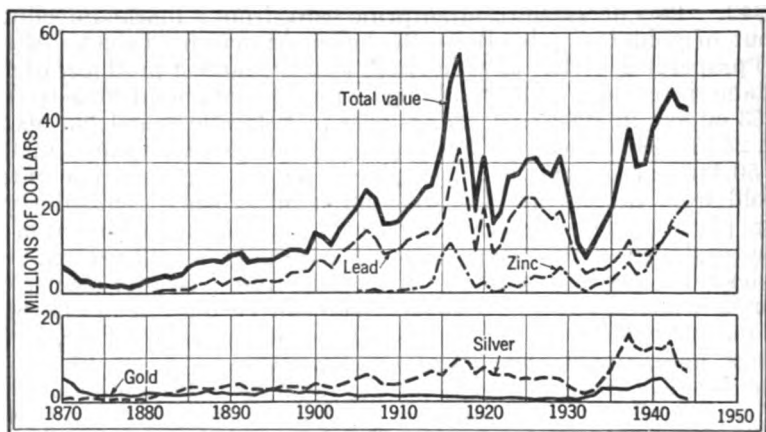


FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Idaho, 1870–1944. The value of copper has been less than \$2,000,000 annually, except in a few years.

The Mineral Point mine remained the largest producer of copper in Idaho, but its output in 1944 was 67 percent less than in 1943. It was followed by the Sunshine, Polaris, Triumph, Osburn tailing plant, and Bunker Hill & Sullivan properties.

Lead.—The output of recoverable lead in Idaho was 167,060,000 pounds in 1944, the smallest output since 1935 and a 13-percent decline from 1943. The total decrease in lead output at the Bunker Hill & Sullivan, Morning, and Hecla mines was 39,933,588 pounds, which more than offset substantial increases at the Osburn tailing dump, Sunshine, Polaris, and Monitor properties and the Sweeny tailing dump. About 92 percent of the State total lead came from the Coeur d'Alene region; most of the remainder was produced in the Warm Springs, Bayhorse, Lava Creek, Deadwood Basin, Moyie Yahk, Texas, and Clark Fork districts. Zinc-lead ore and old tailings (2,330,974 tons) from the Coeur d'Alene region yielded 73 percent of the State total lead; and lead ore, chiefly from the Coeur d'Alene region, yielded nearly 17 percent; the remainder came largely from

zinc-lead ore in the Warm Springs district and from zinc slag and silver ore in the Coeur d'Alene region. Lead recovered from zinc-lead ore and old tailings decreased 32,501,118 pounds; but lead from lead ore increased 3,236,449 pounds, that from zinc ore and slag 2,407,360 pounds, and that from silver ore 1,225,231 pounds.

In 1944 the combined lead output of the four largest producers—the Bunker Hill & Sullivan, Morning, Star, and Page—was 75,564,904 pounds or more than 45 percent of the State total. In 1943 the combined lead output of these properties and the Hecla mine was 126,092,988 pounds. Other important producers in 1944 were the Osburn tailing plant, Tamarack, Sherman, Triumph, Sunshine (Chester vein), Polaris (Chester vein), Hecla, Sweeny tailing dump, Frisco, Monitor, and Clayton properties.

Zinc.—The output of recoverable zinc in Idaho was 182,744,000 pounds in 1944—the largest output in any year in the history of the State and a 5-percent increase over 1943. Idaho as a zinc-producing State moved from third place in 1943 to second in 1944, passing New Jersey but not yet overtaking Oklahoma. Marked increases in output of zinc at the Bunker Hill & Sullivan zinc slag-fuming plant, Osburn tailing plant, Monitor, Page, Little Pittsburg, Highland-Surprise, Nabob, and Douglas properties more than offset substantial decreases at the Morning, Hecla, Star, and Tamarack properties. More than 93 percent of the State total zinc in 1944 came from the Coeur d'Alene region and nearly all the remainder from the Warm Springs, South Mountain, Lava Creek, Deadwood Basin, Bayhorse, and Moyie Yahk districts. Zinc-lead ore and old tailings concentrated yielded 86 percent of the State total zinc, zinc slag fumed and zinc slag smelted 12 percent, and lead ore concentrated and zinc ore concentrated nearly all the remainder.

Eleven properties—the Star, Morning, Bunker Hill & Sullivan mine, Page, Osburn tailing plant, Bunker Hill smelter slag dump, Tamarack, Triumph, Bunker Hill & Sullivan zinc slag-fuming plant, Monitor, and Frisco—produced 80 percent of the State total zinc in 1944.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1944, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Adams.....	3	-----	7	\$245	426	\$303
Bonne.....	15	-----	7,954	278,390	634,922	451,500
Bow.....	5	5	483	16,905	6,857	4,876
Bonner.....	5	-----	1	35	37,478	26,651
Boundary.....	2	-----	896	31,360	12,631	8,982
Butte.....	2	-----	219	7,665	14,549	10,346
Camas.....	2	-----	7	245	3,375	2,400
Cassia.....	1	-----	1	35	97	69
Cook.....	1	-----	1	35	547	389
Custer.....	15	1	509	17,815	276,636	196,719
Elmore.....	1	2	4,650	162,750	17,408	12,379
Gem.....	1	-----	70	2,450	1,142	812
Idaho.....	2	8	50	1,750	59	42
Lemhi.....	7	2	43	1,505	55,018	39,124
Owyhee.....	1	1	85	2,975	33,279	23,665
Shoshone.....	47	1	2,075	72,625	8,669,371	6,164,886
Teton.....	2	-----	7,957	278,495	167,819	119,338
Total, 1944.....	112	20	25,008	875,280	9,931,614	7,062,481
	127	30	30,808	1,078,280	11,700,180	8,320,128

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1944, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams.....	48,000	\$6,480					\$7,028
Blaine.....	273,000	\$6,855	6,885,000	\$550,800	8,529,500	\$972,363	2,289,908
Boise.....	1,000	135		9,000			22,636
Bonner.....	1,400	189	277,000	22,160	16,500	1,881	50,916
Boundary.....	11,000	1,485	357,000	28,560	282,000	32,148	102,835
Butte.....	21,000	2,835	532,000	42,560	707,500	80,655	144,061
Camas.....	400	54	8,400	672	14,500	1,653	5,024
Cassia.....			7,600	608			712
Clark.....	1,000	135	211,000	16,880			17,439
Custer.....	218,000	29,430	4,205,000	336,400	607,500	69,255	649,619
Elmore.....							175,125
Gem.....	200	27	11,000	880	8,500	969	5,135
Idaho.....			2,000	160	13,500	1,539	3,491
Lemhi.....	78,000	10,530	472,000	37,760			88,919
Owyhee.....	94,000	12,690	64,000	5,120	1,392,000	158,688	203,138
Shoshone.....	2,578,000	348,030	153,625,000	12,290,000	170,454,000	19,431,756	38,307,297
Valley.....	51,000	6,885	394,000	31,520	718,500	81,909	518,147
Total, 1943.....	3,376,000	455,760	167,060,000	13,364,800	182,744,000	20,832,816	42,591,137
	4,648,000	604,240	192,914,000	14,468,550	173,414,000	18,728,712	43,199,910

Gold and silver produced at lode mines in Idaho in 1944, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver	County	Ore sold or treated	Gold	Silver
	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>		<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>
Adams.....	203	7	426	Elmore.....	43,573	4,648	17,408
Blaine.....	119,963	7,954	634,922	Gem.....	108	70	1,142
Boise.....	217	418	6,840	Idaho.....	74	6	52
Bonner.....	4,942	1	37,478	Lemhi.....	30,737	83	55,018
Boundary.....	10,321	896	12,631	Owyhee.....	6,721	84	33,279
Butte.....	8,484	219	14,549	Shoshone.....	2,765,483	2,072	8,669,371
Camas.....	224	7	3,375	Valley.....	227,170	7,957	167,819
Cassia.....	19	1	87				
Clark.....	586	1	547				
Custer.....	52,213	498	276,629	Total, 1943.....	3,271,038	24,872	9,931,583
					2,741,747	30,553	11,700,111

Gold and silver produced at placer mines in Idaho in 1944, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dredges						Total	
					Dry-land ¹		Dragline floating ¹		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Boise	65	17	-----	-----	-----	-----	-----	-----	-----	-----	65	17
Custer	11	7	-----	-----	-----	-----	-----	-----	-----	-----	11	7
Elmore	2	-----	-----	-----	-----	-----	-----	-----	-----	-----	2	-----
Idaho	29	7	15	-----	-----	-----	-----	-----	-----	-----	44	7
Lemhi	10	-----	-----	-----	-----	-----	-----	-----	-----	-----	10	-----
Owyhee	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	-----
Shoshone	-----	-----	3	-----	-----	-----	-----	-----	-----	-----	3	-----
Total, 1943	118	31	18	-----	-----	-----	-----	-----	-----	-----	136	31
	249	69	6	-----	-----	-----	-----	-----	-----	-----	255	69

¹ A floating washing plant supplied with gravel by a dragline excavator is called a "dragline floating dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

MINING INDUSTRY

In spite of a serious labor shortage throughout 1944, especially at the large zinc-lead properties in the Coeur d'Alene region, more ore, old tailings, and slag were mined and treated than in any year in the history of Idaho. However, the 19-percent gain over the total for 1943 resulted principally from an increased output of zinc-lead old tailings and zinc slag. The output of zinc-lead ore and old tailings (by far the chief output of the State) increased 31 percent, zinc ore and slag 191 percent, and lead ore nearly 7 percent; but dry siliceous ores decreased 31 percent. Nearly all the gold ore mined in Idaho in 1944 came from two properties—one in the Middle Boise (Atlanta) district and the other in the Yellow Pine district; 71 percent of the silver ore, 93 percent of the lead ore, 94 percent of the zinc ore and slag, and 92 percent of the zinc-lead ore and old tailings came from various properties in the Coeur d'Alene region; and 88 percent of the copper ore came from one mine in the Alder Creek (Mackay) district.

ORE CLASSIFICATION

Details on ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Idaho in 1944, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Dry and siliceous gold ore.....	14	256,640	13,270	136,063	6,752	.....	.....
Dry and siliceous gold-silver ore.....	1	80	20	952	200	200	.....
Dry and siliceous silver ore.....	21	108,527	115	2,216,991	954,951	2,067,589	40,120
Copper ore.....	36	365,247	13,405	2,354,006	961,903	2,067,789	40,120
Zinc ore.....	5	3,232	236	3,854	236,024	.....	.....
Lead-copper ore.....	33	252,944	365	3,179,646	541,756	27,610,941	1,827,651
Lead ore.....	1	39	.....	8,307	4,050	14,840	.....
Zinc-lead ore.....	6	128,982	89	75,221	95,512	3,144,660	23,721,010
Slag.....	53	2,520,594	10,777	4,310,549	1,536,755	134,215,770	157,155,219
Total, lode mines.....	* 112	3,271,038	24,872	9,931,583	3,376,000	167,060,000	182,744,000
Total, placers.....	20	.....	136	31	.....	.....	.....
Total, 1944.....	132	3,271,038	25,008	9,931,614	3,376,000	167,060,000	182,744,000
	157	2,741,747	30,808	11,700,180	4,648,000	192,914,000	173,414,000

* Includes 115,281 tons of zinc slag.

* A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

METALLURGIC INDUSTRY

Of the 3,271,038 tons of ore produced in 1944 in Idaho, 3,140,182 tons (96 percent) were treated at concentration and fuming plants, 57,231 tons (nearly 3 percent) were shipped crude to smelters, and 73,625 tons (1 percent) were treated at amalgamation mills.

Concentration plants in 1944 treated 211,382 tons of gold ore, 156,947 tons of silver ore, 500 tons of copper ore, 250,079 tons of lead ore, 13,521 tons of zinc ore, and 2,520,578 tons of zinc-lead ore and old tailings. Although 76,664 tons of current hot zinc slag were fumed and 78,106 tons of old dump zinc slag were smelted and fumed

in 1944, only the dump slag and 37,175 tons of hot slag were credited directly to the fuming-plant operation; the remainder of the hot slag (39,489 tons) was credited to various producers of the ores and concentrates that contributed during the year to the slag-making material.

Ore treated at straight amalgamation mills in 1944 totaled 84 tons and that at combined amalgamation and concentration plants, 43,541 tons; none was treated at cyanidation plants.

The Bunker Hill & Sullivan Mining & Concentrating Co. operated its Bradley lead smelter and refinery at near capacity in 1944 on ore and concentrates, chiefly from mines and mills in the Coeur d'Alene region. The company also operated its antimony and bismuth plant, 1,700-ton flotation mill (including sink-and-float unit), 300-ton tailing-treatment plant for recovery of silver, iron, and lead from old jig tailings, and 450-ton zinc slag-fuming plant at Bradley. The slag-fuming plant yielded 23,458 dry tons of de-leaded zinc fume and 4,077 dry tons of lead fume. The electrolytic antimony plant (100-ton capacity) of the Sunshine Mining Co. near Kellogg was closed in March, when the Sunshine Mining Co. decided to concentrate all its available manpower on mining lead-silver ore from its Chester vein instead of mining silver-copper-antimony ore from its Sunshine vein. The Sullivan Mining Co. operated continuously at capacity its 100-ton electrolytic zinc plant near Bradley on zinc and zinc-lead concentrates and oxide zinc fume produced mainly from plants in the Coeur d'Alene region. During the year the Sullivan Mining Co. and the Metals Reserve Company stock-piled several thousand tons of zinc concentrates at Bradley. Antimony, tungsten, and antimony-iron-gold concentrates were produced throughout the year in the 800-ton flotation mill of the Bradley Mining Co. at Stibnite and tungsten concentrates and silver-copper-lead-iron concentrates in the Ima mill at Patterson. During the spring months of 1944 the Bradley Mining Co. remodeled an old building in Boise to house a leaching plant. Some of the tungsten concentrates produced at the company mill at Stibnite were hauled to this leaching plant, where muriatic acid was used to eliminate the apatite and calcite and caustic soda to eliminate the antimony from the concentrates; this additional treatment produced a 70-percent tungstic oxide concentrate, which was sold direct to the steel plants.

Mine production of metals in Idaho in 1944, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Ore amalgamated.....	43, 625	2, 429	1, 230			
Concentrates smelted.....	¹ 339, 103	20, 892	9, 829, 651	3, 136, 937	182, 894, 337	168, 209, 683
Ore smelted.....	87, 231	1, 551	100, 702	239, 063	4, 165, 663	14, 534, 317
Placer.....		136	31			
Total, 1943.....		25, 008 30, 808	9, 931, 614 11, 700, 180	3, 376, 000 4, 648, 000	167, 060, 000 192, 914, 000	182, 744, 000 173, 414, 000

¹ Includes 139 tons of lead fume and 6,150 tons of zinc fume from 37,175 tons of zinc slag fumed.

The production of metals from amalgamation mills (with or without concentration equipment) in Idaho in 1944, by counties, in terms of recovered metals

County	Material treated	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	Fine ounces	Fine ounces	Short tons	Fine ounces	Fine ounces	Pounds	Pounds
Adair	84	110	38					
Blaine	43, 541	2, 319	1, 192	321	1, 991	14, 467		
Total, 1943	43, 625	2, 429	1, 230	321	1, 991	14, 467		
	55, 020	8, 742	4, 468	830	4, 819	38, 880		

The production of metals from concentrating mills in Idaho in 1944, by counties, in terms of recovered metals

County	Ore treated	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	Short tons	Fine ounces	Fine ounces	Pounds	Pounds	Pounds
Adair	116, 744	37, 023	7, 478	619, 142	264, 223	6, 821, 624	8, 493, 675
Blaine	4, 913	286	1	36, 430	1, 400	265, 378	12, 800
Blaine	10, 321	993	896	12, 631	11, 000	357, 000	282, 000
Blaine	8, 484	1, 793	219	14, 549	21, 000	532, 000	707, 500
Blaine	97	28	3	1, 377	165	6, 666	14, 500
Blaine	48, 868	4, 121	113	250, 953	59, 949	3, 851, 726	607, 500
Blaine	104	29	66	1, 131	200	11, 000	8, 500
Blaine	70	16		24		2, 000	13, 500
Blaine	29, 587	1, 046	12	44, 318	56, 000	91, 300	
Blaine	6, 721	1, 826	84	33, 279	94, 000	64, 000	1, 392, 000
Blaine	12, 697, 103	279, 485	2, 072	8, 633, 526	2, 578, 000	150, 497, 643	155, 959, 208
Blaine	227, 170	12, 136	7, 957	167, 819	51, 000	394, 000	718, 500
Total, 1943	13, 140, 182	338, 782	18, 901	9, 815, 184	3, 136, 937	162, 894, 337	168, 209, 683
	2, 669, 059	361, 860	14, 691	11, 526, 370	4, 534, 662	191, 264, 293	173, 331, 590

¹ Includes 37,175 tons of hot zinc slag fumed.

Gross metal content of concentrates produced from ores mined in Idaho in 1944, by classes of concentrates smelted

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	Fine ounces	Fine ounces	Pounds	Pounds	Pounds
Gold	4, 424	7, 909	39, 467			
Gold-silver	6, 975	1, 835	92, 156			
Silver	1, 017	34	392, 774	564, 598	6, 561	1, 221
Copper	123, 879	4, 146	6, 614, 163	1, 566, 384	147, 431, 615	17, 096, 129
Lead	5, 889	271	1, 874, 778	639, 644	2, 491, 305	412, 591
Lead	146, 126	1, 533	562, 037	644, 426	8, 303, 587	154, 136, 421
Lead (from zinc-lead ore and lead ore)	22, 329	1, 166	190, 908	90, 190	6, 890, 574	18, 637, 576
	28, 464	3, 998	69, 488	84, 465	1, 234, 932	1, 348, 077
Total, 1943	339, 103	20, 892	9, 835, 771	3, 589, 707	166, 358, 574	191, 632, 015
	362, 690	19, 410	11, 565, 250	4, 952, 032	197, 485, 928	208, 345, 747

¹ Includes 139 tons of lead fume produced at a zinc slag-fuming plant.

² Includes 6,150 tons of zinc fume produced at a zinc slag-fuming plant.

Mine production of metals from Idaho concentrates shipped to smelters in 1944, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Blaine.....	37,023	7,478	619,142	264,223	6,821,624	8,493,675
Bonner.....	286	1	36,430	1,400	265,378	12,800
Boundary.....	993	896	12,631	11,000	357,000	282,000
Butte.....	1,793	219	14,549	21,000	532,000	707,500
Camas.....	28	3	1,377	165	6,666	14,500
Custer.....	4,121	113	250,958	59,949	3,851,728	607,500
Elmore.....	321	1,991	14,467			
Gem.....	29	66	1,131	200	11,000	8,500
Idaho.....	16		24		2,000	13,500
Lemhi.....	1,046	12	44,318	56,000	91,300	
Owyhee.....	1,826	84	33,279	94,000	64,000	1,392,000
Shoshone.....	1,279,485	2,072	8,633,526	2,578,000	150,497,643	155,969,208
Valley.....	12,136	7,957	167,819	51,000	394,000	718,500
Total, 1943.....	1,339,103	20,892	9,829,651	3,136,937	162,894,337	168,209,683
	362,690	19,410	11,565,250	4,534,662	191,264,293	173,331,590

BY CLASSES OF CONCENTRATES

Dry gold.....	4,424	7,909	39,467			
Dry gold-silver.....	6,975	1,835	92,166			
Copper.....	1,017	34	392,774	547,587	4,040	
Lead.....	1,123,879	4,146	6,614,163	1,314,479	144,882,721	13,051,373
Lead-copper.....	5,889	271	1,874,778	533,833	2,443,884	137,844
Zinc.....	1,146,126	1,533	555,917	584,733	7,798,655	188,345,193
Zinc-lead.....	22,329	1,166	190,908	79,523	6,689,174	16,675,273
Dry iron (from zinc-lead ore and lead ore).....	28,464	3,998	69,488	76,782	1,075,863	
	339,103	20,892	9,829,651	3,136,937	162,894,337	168,209,683

¹ Includes 139 tons of lead fume and 6,150 tons of zinc fume produced at a zinc slag-fuming plant.

² Includes 139 tons of lead fume produced at a zinc slag-fuming plant.

³ Includes 6,150 tons of zinc fume produced at a zinc slag-fuming plant.

Gross metal content of Idaho crude ore shipped to smelters in 1944, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Dry and siliceous gold.....	1,633	1,097	3,210	7,116		
Dry and siliceous gold-silver.....	80	20	952	205	280	
Dry and siliceous silver.....	1,580	45	14,958	2,249	69,504	22,479
Copper.....	2,732	219	3,610	223,071		
Lead.....	2,865	169	37,110	9,838	1,227,953	91,178
Lead-copper.....	39		8,307	4,765	15,495	1,068
Zinc.....	1,78,286	1	32,306	594	3,044,387	18,110,140
Zinc-lead.....	16		249		4,595	4,312
Total, 1943.....	1,87,231	1,551	100,702	247,838	4,362,214	18,229,177
	17,668	2,401	130,393	120,344	1,774,936	104,061

¹ Includes 78,106 tons of zinc slag smelted and fumed.

Mine production of metals from Idaho crude ore shipped to smelters in 1944, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Adair	203	7	426	48,000		
Blaine	3,219	476	15,780	8,777	63,376	35,825
Bonneville	133	308	6,802	1,000	9,000	
Butte	29		1,048		11,622	3,700
Carleton	127	4	1,998	235	1,734	
Cassia	19	1	97		7,600	
Clearwater	586	1	647	1,000	211,000	
Coe	3,345	385	25,671	158,051	353,274	
Condon	32	338	1,749			
Cotton	4	4	11			
Craig	4	6	28			
Crowley	1,150	21	10,700	22,000	380,700	
Elmore	178,380		35,845		3,127,357	14,494,792
Total, 1943	187,231	1,551	100,702	239,063	4,165,663	14,534,317
Total, 1944	17,668	2,401	130,393	113,338	1,649,707	82,410

BY CLASSES OF ORE

Dry and siliceous gold	1,633	1,097	3,210	6,752		
Dry and siliceous gold-silver	80	20	952	200	200	
Dry and siliceous silver	1,580	45	14,958	2,163	43,103	
Copper	2,732	219	3,610	218,200		
Lead-copper	2,865	169	37,110	7,193	1,180,200	13,792
Zinc	39		8,307	4,050	14,840	
Lead-zinc	178,286	1	32,306	606	2,922,820	14,516,825
Lead	16		249		4,500	3,700
Total	187,231	1,551	100,702	239,063	4,165,663	14,534,317

Includes 78,106 tons of zinc slag smelted and fumed.

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1944, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	Fine ounces	Fine ounces	Fine ounces	Fine ounces	Fine ounces	Pounds	Pounds	Pounds		
Adams County: Seven Devils	3		263	7			426		426	48,000			\$7,028
Blaine County:													
Lava Creek	1		4,947	22		22	5,400		5,400	9,400	127,000	440,500	66,256
Little Wood River	3		264	1			2,288		2,288	1,400	45,600	18,500	7,608
Mineral Hill and Camas	5		2,331	287		287	7,335		7,335	8,600	46,200	70,500	28,155
Sawtooth (Vienna)	1		80	20		20	952		952	200			1,420
Warm Springs	5		112,341	7,624		7,624	618,947		618,947	233,400	6,666,000	8,000,000	2,186,469
Boise County:													
Boise Basin	2	5			65	426	6,819	17	6,836	1,000	9,000		20,626
Summit Flat	3		24	57		57	21		21				2,010
Bonner County:													
Clark Fork	3		4,746				35,453		35,453	1,200	267,800	11,000	48,051
Lakeview	2		196	1	1	2	2,025		2,025	200	9,200	5,500	2,865
Boundary County:													
Moyie Yahk	1		9,421	896		896	11,994		11,994	10,600	326,600	279,500	99,311
Port Hill	1		900				637		637	400	30,400	2,500	3,224
Butte County:													
Dome	1		450				208		208		24,800		2,132
Lava Creek	1		8,034	219		219	14,341		14,341	21,000	507,200	707,500	141,929
Camas County:													
Little Smoky and Carriatown	2		224	7		7	3,375		3,375	400	8,400	14,500	5,024
Cassia County: Stokes	1		19	1		1	97		97		7,600		712
Clark County: Birch Creek	1		586	1		1	547		547	1,000	211,000		17,439
Custer County:													
Alder Creek	4		3,292	229		229	4,763		4,763	170,600	64,800	35,000	43,607
Alta (Little Fall Creek)	2		68				879		879	200	2,700	4,500	1,381
Bayhorse	7		48,830	102		102	270,644		270,644	47,000	4,137,500	568,000	598,125
Yankee Fork	2	1	23	167	11	178	343	7	350	200			6,506
Elmore County: Middle Boise	1		43,573	4,648	2	4,650	17,408		17,408				175,129
Gen County: West View	1		108	70		70	1,142		1,142	200	11,000	8,500	5,138
Idaho County:													
Camp Howard (Salmon River)	1				4	4							140
Dixie	1		4	6			28		28				230
Elk City		1			4	4							230
Florence and French Creek		2			14	14		7					140
Lowell	1		70				24				2,000	13,500	495
													1,716

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Idaho (Blaine River)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Leadville County	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Firehole	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Madison	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Macdonald	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
North Fork	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Texas	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Unorganized (Reno)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Owyhee County:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Snake River	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
South Mountain	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Shoshone County:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Beaver	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Coeur d'Alene	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Eagle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Evolution	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Hunter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Lelande	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Placer Center	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Yreka	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Valley County:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Deadwood Basin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Yellow Pine	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Total Idaho	112	20	3,271,038	24,872	136	25,008	9,931,614	3,376,000	167,060,000	182,744,000	42,591,137	103,481	394,000	718,500	14,611,816	3,040,897	15,711,500	12,870,200	17,191,700	34,143,000	22,671,000	76,900	5,500	7,865	1,000	1,555,000	5,211,502	735,286	521,339	109,200	106,200	449,400	51,000	117,156	9,931,614	3,376,000	167,060,000	182,744,000	42,591,137

! Lava Creek district lies in both Blaine and Butte Counties.

ADAMS COUNTY

Leasing operations in 1944 at three properties near Cuprum in the Seven Devils district produced a total of 203 tons of carbonate copper ore; 153 tons came from the Arkansaw-Decorah group, 32 tons from the Helena claim, and 18 tons from the Lockwood group.

BLAINE COUNTY

Lava Creek district.—Hoyt Ray worked the Paymaster mine, 32 miles southwest of Arco, throughout the year and shipped 4,947 tons of zinc-lead ore to a custom flotation mill at Midvale, Utah, where it was separated into lead concentrates, zinc concentrates, and iron concentrates.

Little Wood River (Muldoon) district.—Leasing at the Eagle Bird mine in Garfield Canyon during the summer months of 1944 produced 162 tons of zinc-lead ore and 39 tons of oxide silver-lead ore. The remainder of the district output was principally 39 tons of zinc-lead ore and 19 tons of silver-lead ore produced from the Idaho Muldoon property.

Mineral Hill and Camas district.—In 1944 a total of 1,820 tons of ore and 511 tons of old tailings was shipped from five properties in the Mineral Hill and Camas district; 1,027 tons were siliceous gold ore shipped direct to a smelter from the Camas mine, 792 tons were zinc-lead ore produced from the Snoose mine and shipped to custom mills in Utah, and the remainder was largely silver old tailings (461 tons) from the Red Elephant property.

Sawtooth (Vienna) district.—A lessee worked the Vienna mine, 45 miles northwest of Ketchum, in 1944 and shipped 80 tons of high-silica gold-silver ore to a smelter in Utah.

Warm Springs district.—The principal output of the Warm Springs district in 1944 continued to be zinc-lead-silver ore from the Triumph-North Star-Independence groups near Ketchum operated by the Triumph Mining Co. The company operated the groups throughout the year and treated 52,060 tons of low-grade zinc-lead-silver ore in its 300-ton concentrator, recovering lead-silver concentrates and zinc-lead middlings. The middlings (13,449 tons) and 57,667 tons of higher-grade zinc-lead-silver ore were shipped to custom flotation mills at Bauer and Tooele, Utah, for treatment, and the lead-silver concentrates (2,893 tons) were shipped direct to a lead smelter. In addition, 888 tons of old tailings (silver) were shipped to a copper smelter. The rest of the district output comprised 798 tons of zinc-lead ore and 180 tons of oxide zinc ore produced from the Homestake mine near Ketchum, 474 tons of siliceous gold ore from the June Day mine, 200 tons of zinc ore from the Lucky Boy mine, and 74 tons of zinc-lead ore from the Blue Kitten claim.

BOISE COUNTY

Boise Basin district (Centerville, Placerville, Idaho City, Pioneerville, Quartzburg).—Mining operations (both lode and placer) in the gold district of Boise Basin have been negligible since October 1942 when the War Production Board promulgated the gold-mine closing order. The principal output from lode mines in the district in 1944 was 70 tons of old mill cleanings (containing chiefly gold) shipped from the Gold Hill & Iowa mill, 62 tons of high-grade gold-silver ore shipped

direct to a smelter from the Come-Back mine, and 60 tons of gold ore from the Juliana claim treated by amalgamation. The placer output of 65 ounces of gold and 17 ounces of silver resulted mainly from clean-ups around former dredging operations.

Summit Flat district.—All the output (24 tons) in the Summit Flat district in 1944 was high-grade gold ore produced from the Jessie, Rock Creek, and Viking properties and treated by amalgamation.

BONNER COUNTY

Clark Fork district (formerly part of Pend d'Oreille district).—The principal output in the Clark Fork district in 1944 was 4,714 tons of silver-lead ore from the Hope (Elsie K.) and Whitedelf properties near Clark Fork. Hope Silver-Lead Mines, Inc., operated its 150-ton flotation mill on silver-lead ore (2,843 tons) produced from the Hope mine until March 30, when milling operations ceased owing to an insufficient supply of ore, caused by a shortage of miners, to keep the mill running. In April the company began sinking a vertical shaft at the property so as to develop ore bodies at greater depth. The Whitedelf Mining & Developing Co. rehabilitated its mine and 50-ton mill late in 1943 after being closed for 2 years; in 1944 the company treated 1,858 tons of silver-lead ore by flotation. Nearly all the remainder of the district output was lead ore (32 tons) produced from the Laurence mine.

Lakeview district.—About 180 tons of silver ore (containing some lead and zinc) were produced from the Hewer (Idaho Lakeview) mine in 1944 and treated by flotation. The rest of the district output was 16 tons of zinc-lead-silver ore shipped direct to a smelter from the old Cement mine.

BOUNDARY COUNTY

Moyie Yahk district.—Mining and milling of gold-silver-lead-zinc ore at the Regal property, 14 miles northeast of Bonners Ferry, by Silver Crescent, Inc., were continuous throughout the year. The company reported that 9,421 tons of sulfide ore containing 980 ounces of gold, 13,200 ounces of silver, 14,000 pounds of copper, 423,000 pounds of lead, and 550,000 pounds of zinc were treated by flotation; zinc-lead concentrates and zinc concentrates were shipped to smelters at Bradley, Idaho.

Port Hill district.—The Idaho-Continental mine and mill were idle most of 1944, resulting in a marked decrease in the district production of silver and lead; however, the property was taken over late in the year by the Idaho-Continental Leasing Co., and 900 tons of lead ore were treated by flotation.

BUTTE COUNTY

Dome district.—In 1944 approximately 450 tons of old tailings (containing chiefly lead) from the Wilbert dump near Howe were treated by flotation.

Lava Creek district.—The Era Mining & Development Co. mined zinc-lead ore throughout the year at the Horn Silver mine, 20 miles southwest of Arco; a total of 8,034 tons of sulfide ore, averaging

0.03 ounce of gold and 1.97 ounces of silver to the ton, 0.20 percent copper, 3.48 percent lead, 6.23 percent zinc, and 6.50 percent iron was shipped to a custom flotation mill in Utah.

CAMAS COUNTY

Little Smoky and Carrietown district.—A lessee worked the waste dump of the Carrie Leonard property in 1944 and shipped 97 tons of zinc-lead-silver ore to a custom mill and 49 tons of silver ore to a smelter. Silver ore (78 tons) was shipped from the Stormy Galore mine.

CLARK COUNTY

The only output in Clark County in 1944, as in 1943, was lead ore produced from the Scott mine on Birch Creek. The Birch Creek Mining Co., Ltd., operated the mine continuously and shipped 586 tons of oxide lead ore to a smelter in Utah.

CUSTER COUNTY

Alder Creek district.—The Mackay Exploration Co. did considerable work in 1944 in rebuilding the flotation mill, installing machinery at the power plant, and constructing a 2¼-mile transmission line from the power plant to the mill at its Empire property near Mackay. Mining of copper ore at the mine was begun in July, and during the remainder of the year 2,330 tons of crude copper ore were shipped to the smelter at Garfield, Utah, and 500 tons of similar ore were treated in the company mill. The rest of the district output was mainly 252 tons of zinc-lead ore from the Horseshoe mine and 200 tons of lead ore from the Champion mine.

Alta (Little Fall Creek) district.—Most of the output in the Alta district in 1944 was 36 tons of sulfide zinc-lead ore and 17 tons of siliceous silver ore shipped from the Long Trail claim 14 miles northeast of Ketchum.

Bayhorse district.—Mining and milling of zinc-lead ore at the Clayton mine by Clayton Silver Mines continued throughout 1944. The company reported that 39,258 tons of ore, containing an average of 5.72 ounces of silver to the ton, 4.71 percent lead, and 1.58 percent zinc, were treated in its 120-ton flotation mill and yielded 2,644 tons of high-grade lead-silver concentrates and 645 tons of zinc concentrates. More lead-silver concentrates but less zinc concentrates were produced in 1944 than in 1943, resulting in a greater output of lead and silver and a substantial decline in zinc. Swigert Mines operated the Pacific claim of the Salmon River group near Challis most of the year and treated 6,585 tons of oxide lead-silver ore by gravity concentration. The remainder of the district output comprised 2,676 tons of oxide lead-silver ore produced from the South Butte and Red Bird properties, 200 tons of silver ore from the Hoosier claim, 72 tons of lead ore from the Twin Apex group, and 39 tons of high-grade silver-lead-copper ore from the Ramshorn mine.

Yankee Fork district.—Lessees continued in 1944 to work the Fourth of July claim near Sunbeam and shipped 21 tons of high-grade gold ore to a smelter. The rest of the district output was principally placer gold and silver recovered from gravel at the Horse Trail property.

ELMORE COUNTY

Middle Boise (Atlanta) district.—Mining and milling of gold ore at the Boise-Rochester-Monarch property by Talache Mines, Inc., continued from January 1 to November 1, when operations ceased owing to Government restrictions and a shortage of labor. The company reported that 43,541 tons of gold ore were treated in its 400-ton amalgamation and concentration mill in 1944 compared with 53,424 tons in 1943 and that 32 tons of rich gold ore were shipped direct to a smelter. In addition to gold and silver, the milling ore contains arsenic and tungsten, but none of these products were marketed in 1944. The output of placer gold in the district totaled only 2 ounces.

GEM COUNTY

West View district.—The Friday mine at Pearl was worked under lease by the Friday Mining Co. until April 30, when operations ceased owing to exhaustion of commercial ore. During the first 4 months of the year 104 tons of sulfide ore averaging 0.69 ounce of gold and 11.99 ounces of silver to the ton, 5.66 percent lead, and 5.81 percent zinc were shipped to a custom flotation mill in Utah, and 4 tons of high-grade gold ore were shipped direct to a smelter.

IDAHO COUNTY

Most of the mining districts in Idaho County are gold-producing areas (placer and lode), and since War Production Board Order L-208 closing gold mines was issued in October 1942 virtually all the mines in the districts have been idle. In 1944, a little placer gold was recovered from claims in the Camp Howard, Elk City, Florence and French Creek, Newsome, Simpson, and Warren districts, and a little lode gold and silver were produced from the Mammoth mine in the Dixie district; a lessee worked the Rusty Lode claim near Kooskia in the Lowell district and shipped 70 tons of zinc-lead ore to custom flotation mills in Utah.

LEMHI COUNTY

Blue Wing district.—Mining and milling of ore containing hübnerite, galena, tetrahedrite, and pyrite at the Ima property by the Ima Mines Corp. continued throughout the year. The company reported that 29,587 tons of ore were treated in 1944 in its 150-ton concentration plant; tungsten was recovered by gravity and flotation concentration, followed by magnetic separation, and silver, copper, and lead were recovered by bulk sulfide flotation. Lead-copper-silver concentrates (1,046 tons) were shipped to a smelter in Utah, and tungsten concentrates were sent to an eastern market.

Eureka district.—Leasing operations at the Pope-Shenon (Grandview) mine near Salmon in 1944 produced 199 tons of copper ore, which was shipped direct to a smelter.

Junction district.—The total output of the Junction district in 1944 was 40 tons of crude lead-silver ore shipped from the Bullion Apex and Plymouth properties near Leadore.

Texas district.—Milo W. Zook continued in 1944 to operate the Latest Out mine near Gilmore and shipped 725 tons of oxide lead-silver ore to a smelter in Utah.

Unorganized (Reno) district.—The Cabin mine near Reno was worked continuously in 1944, and 185 tons of oxide lead-silver ore were shipped to a smelter.

OWYHEE COUNTY

South Mountain district.—Mining of ore, containing sphalerite, galena, and chalcopryrite, at the Golconda mine by the South Mountain Mining Co. was continuous throughout the year. The company reported that 6,721 tons of zinc-lead-copper-silver ore were shipped to the International flotation mill at Tooele, Utah, where it was separated into lead-copper-silver concentrates, zinc concentrates, and iron concentrates.

SHOSHONE COUNTY

COEUR D'ALENE REGION

In 1944 the Coeur d'Alene region of Shoshone County remained the largest silver-producing area in the United States and ranked second in lead and zinc; it produced 87 percent of Idaho's silver, 76 percent of the copper, 92 percent of the lead, and 93 percent of the zinc. The value of the metal output of the region was \$38,307,297 compared with \$38,594,728 in 1943. The output of each metal except zinc decreased; gold declined 8 percent, silver 16 percent, copper 35 percent, and lead more than 14 percent. The output of zinc in 1944 exceeded the record of 1943 by 7 percent. The chief producers of zinc in the region in 1944, according to rank (each producing more than 12,000,000 pounds), were the Star, Bunker Hill & Sullivan zinc slag-fuming plant, Bunker Hill & Sullivan mine, Morning, Page, Osburn tailing plant, and Tamarack properties; the chief producers of lead, according to rank (each producing more than 7,000,000 pounds), were the Bunker Hill & Sullivan, Morning, Star, Page, Osburn tailing plant, Tamarack, and Sherman properties; and the chief producers of silver, according to rank (each producing more than 300,000 ounces), were the Sunshine, Polaris, Bunker Hill & Sullivan, Osburn tailing plant, Page, Silver Dollar, Morning, and Silver Syndicate properties.

Of the total material (2,765,483 tons) produced in 1944 in the Coeur d'Alene region, 84 percent was zinc-lead ore and old tailings, more than 8 percent lead-silver ore, 4 percent zinc slag, and nearly all the remainder silver ore.

Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, 1943-44, and total, 1884-1944, in terms of recovered metals

Year	Mines producing		Ore	Gold (lode and placer)	Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer							
			Short tons	Fine ounces	Fine ounces	Pounds	Pounds	Pounds	
1943.....	47	3	2,270,385	2,250	10,302,840	3,974,000	179,626,000	159,268,000	\$38,594,728
1944.....	47	1	2,765,483	2,075	8,669,371	2,578,000	153,625,000	170,454,000	38,307,297
Total, 1884-1944.....	.....	.....	(1)	389,410	419,516,106	² 63,536	² 5,412,089	² 1,051,407	1,054,993,601

¹ Figures not available.

² Short tons.

Beaver district.—The output of the Beaver district in 1944 was 191,180 tons of zinc-lead ore and 6,600 tons of zinc ore compared with 55,922 tons of zinc-lead ore and 60 tons of lead ore in 1943. The most important output was 77,003 tons of ore, averaging 1.05 ounces of silver to the ton, 2.48 percent lead, and 5.82 percent zinc, from the Amazon-Carlisle-Portland groups (Monitor Mining Co.) treated in the Hercules, Dayrock, and Carlisle flotation mills near Wallace. According to the printed annual report of the Monitor Mining Co., the output of ore in 1944 was more than double that in 1943; however, labor shortages prevented full production. Since the fall of 1942 the company has completely equipped its four largest known ore bodies, the grade of which is low; present operations would not be profitable without premiums above the present ceiling prices of 6.50 cents a pound for lead and 8.25 cents for zinc. Despite the shortage of manpower, the Amazon and Carlisle ore bodies (and the Silver Tip to some extent) have been developed to a point where substantial reserves of low-grade ore are known to exist.

Sunset Lease worked the Sunset mine continuously and hauled 22,547 tons of zinc-lead ore to the Golconda custom flotation mill near Wallace. The rest of the district output comprised 6,600 tons of zinc ore from the Interstate-Callahan waste dump and 1,630 tons of zinc-lead ore from the Nipsic claim of the Interstate-Callahan group treated in the custom flotation mill of Zanetti Bros. near Wallace. An important body of zinc-lead ore was discovered in November in the Nipsic claim by Daylight Lease.

Eagle district.—The Crystal Lead Mines Co. operated its property near Murray in 1944 and hauled 994 tons of lead ore to the Hercules custom mill.

Evolution district.—The output of the Evolution district in 1944 comprised 724,121 tons of zinc-lead old tailings, 64,515 tons of lead-silver ore, 40,674 tons of silver ore, and 28,635 tons of silver-copper-antimony ore, compared with 127,318 tons of zinc-lead old tailings, 220,708 tons of silver-copper-antimony ore, 28,000 tons of silver ore, and 21,405 tons of lead-silver ore in 1943. Nearly all the old tailings in 1944 came from the Osburn dump, all the lead-silver ore and most of the silver ore from the Chester vein and the Silver Syndicate fault zone, and nearly all the silver-copper-antimony ore from the Mineral Point mine. The Osburn tailing dump became a large producer of silver, lead, and zinc in 1944 as a result of continuous operation of its 2,500-ton sink-and-float plant and 500-ton flotation mill by the Hecla Mining Co. The company reported that 720,521 tons of old tailings, containing an average of 1.25 ounces of silver to the ton, 1.60 percent lead, 1.75 percent zinc, and a little copper, were treated during the year in the sink-and-float plant; the resulting zinc-lead middling (500,317 tons) was treated in the Osburn, Polaris, and Hecla flotation mills where it was separated into lead concentrates and zinc concentrates. The output of silver-copper-antimony ore from the Sunshine mine of the Sunshine Mining Co. dropped from 141,955 tons in 1943 to 3,298 tons in 1944 as mining operations on the Sunshine vein were suspended in March to concentrate all available labor on mining lead-silver ore from the Chester vein and the Silver Syndicate fault zone. This mineral area (known as Rambo, Omega, and Rotbart) includes property owned by the Sunshine Mining Co., Polaris Mining Co., Silver Dollar Mining Co., and Silver Syndicate, Inc., but all explora-

tion, development, and mining and milling of ore are done by the Sunshine Mining Co. According to the printed annual report of the Sunshine Mining Co. for 1944, a conflict of ownership of ore in the Chester vein in territory adjacent to Sunshine's original east boundary was satisfactorily settled by an agreement creating the Rotbart area in which the ownership was divided equally between the Sunshine Mining Co., Polaris Mining Co., and Silver Dollar Mining Co. The Rotbart area has an east-west dimension of 400 feet and is contained within the Omega area, which continues for about 1,400 feet to the east of the Rotbart area. The Chester vein in the Omega area is owned in equal shares by the Sunshine Mining Co. and Polaris Mining Co. A new agreement was negotiated in 1944 with Silver Syndicate, Inc., in which Silver Syndicate conveyed to Sunshine a 50-percent interest in all Silver Syndicate mineral holdings, including apex rights on some 4,100 feet of length on the strike of the Silver Syndicate fault. The Chester vein has been developed in the Rotbart area on several levels with excellent results. The ore body appears to be wider and above average grade in this area; it is continuous from the 2,500 to the 3,100 level and may reasonably be expected to extend below the 3,700 level. Much additional work will be required to determine fully the extent of the ore zone on the 3,700 level. The most extensive development to date has been on the 3,100 level where the ore is continuous for a length of 1,000 feet. Development in all areas in 1944 comprised 3,985 feet of drifting, 1,001 feet of raising, and 1,208 feet of crosscutting; and diamond drilling of 21 test holes totaled 3,369 feet. Ore reserves were increased as a result of this development, and they will probably be further increased in 1945, resulting from work on the 3,700 level.

The company reported that the total output of ore from the Chester vein and Silver Syndicate fault zone was 91,956 tons (43,975 tons for Sunshine account and 47,981 tons for account of Polaris, Silver Dollar, and Silver Syndicate Co.), averaging 44.6 ounces of silver to the ton, 6.3 percent lead, and a little copper; the concentrates contained 4,052,478 ounces of silver, 881,944 pounds of copper, and 11,358,942 pounds of lead, of which the net for Sunshine account, including 84,685 ounces of silver, 31,485 pounds of copper, and 15,553 pounds of lead produced from the Sunshine vein, was 1,968,166 ounces of silver, 437,968 pounds of copper, and 5,599,246 pounds of lead. The production credited to other companies (Polaris, Silver Dollar, and Silver Syndicate) was 2,168,997 ounces of silver, 475,461 pounds of copper, and 5,775,249 pounds of lead. About 36,950 tons of lead-silver ore were mined in 1944 from the Chester vein by the Sunshine Mining Co. for Polaris Mining Co. account. In addition, 13,231 tons of silver ore from the Polaris vein were hauled to the Sunshine mill for treatment. The Polaris Mining Co. reported that silver ore previously developed in the Polaris vein was completely mined out in 1944 and that exploratory work failed to develop any additional ore. The Polaris 300-ton flotation mill near Osburn operated continuously throughout the year on zinc-lead middling produced at the Osburn sink-and-float plant.

Mining and milling of silver-copper-antimony ore at the Mineral Point property of the Coeur d'Alene Mines Corporation near Osburn were continuous throughout the year. The company reported that the 600-ton flotation mill treated 25,337 tons of ore in 1944 compared with

73,753 tons in 1943. During the first quarter of the year the silver-copper-antimony concentrates (454 tons) were shipped to the leaching and electrolytic antimony plant of the Sunshine Mining Co. to recover the antimony; however, this plant was closed in March and during the remainder of the year the concentrates were shipped direct to the smelter at Tacoma, Wash. According to the corporation printed annual report, the ore treated in 1944 averaged 12.55 ounces of silver to the ton, 1.02 percent copper, and 0.61 percent antimony. The concentrates (848 tons) contained 313,414 ounces of silver, 510,189 pounds of copper, and 303,009 pounds of antimony—a marked decrease from the metal output in 1943. Production was curtailed throughout the year, owing to the difficulty of obtaining miners. Development in 1944, principally on the 2,200 level, comprised 1,068 feet of drifting, 976 feet of crosscutting, and 2,194 feet of diamond drilling. The ore reserves at the end of the year were estimated at 72,369 tons, which is considerably lower than the estimate of December 31, 1943, due to the fact that much ore included in the estimate at that time has proved too low-grade to have commercial value.

Hunter district (Mullan).—A total of 528,015 tons of ore was produced in 1944 from 6 properties in the Hunter district, compared with 539,705 tons of ore from 8 properties in 1943; the most important output was 472,331 tons of zinc-lead ore from the Morning and Star mines. Mining and milling operations at the Morning property of the Federal Mining & Smelting Co. at Mullan continued throughout the year. The 1,250-ton mill treated 163,931 tons of waste-dump ore containing an average of 0.7 ounce of silver to the ton, 1.2 percent lead, and 1.0 percent zinc, and 112,838 tons of mine ore containing an average of 2.2 ounces of silver to the ton, 6.2 percent lead, and 7.3 percent zinc. According to the printed annual report of the company for 1944, operations were on a basis of 6 days per week throughout the year; the mine operated 2 shifts a day until April 24 and 1 shift thereafter owing to a labor shortage. A severe rock burst on May 9 caused considerable damage to the stopes on the 4,250 and 4,450 levels, resulting in a loss in tonnage and grade of ore mined during May and June. The labor shortage continued, with a net loss of 175 men during the year. The crew on January 1, 1945, was about 240 men below normal, and no new labor is available. The shortage of labor was so pronounced in 1944 that the company was unable to conduct the development and shaft sinking which normally would have been done. Obviously, there is a limit to postponement of this work. The war emergency, however, justifies the action so far taken. Ore reserves at the end of the year, including developed and probable ore in both the Morning and You-Like portions of the mine, are estimated at 530,000 tons, a decrease of 90,000 tons from the estimated tonnage at the end of 1943; possible ore is not considered.

The Star mine and 1,000-ton flotation mill of the Sullivan Mining Co. at Burke were operated continuously in 1944 but at a lower rate than in 1943 owing to a shortage of miners; the mill treated 195,562 tons of zinc-lead ore (238,509 tons in 1943), yielding 9,743 tons of lead concentrates and 30,740 tons of zinc concentrates, which contained 145 ounces of gold, 229,819 ounces of silver, 15,620,767 pounds of lead, and 32,078,369 pounds of zinc. The mine continued as the largest producer of zinc in Idaho. Hunter Lease operated the Gold Hunter mine and 500-ton flotation mill at Mullan throughout the

year; 46,200 tons of ore averaging 3.03 ounces of silver to the ton, 2.64 percent lead, and 0.72 percent zinc were treated in 1944 compared with 52,760 tons in 1943. No zinc concentrates were produced in 1944, but the company reported that work was begun late in the year in equipping the mill with a zinc flotation unit. The remainder of the district output comprised 4,581 tons of zinc-lead-silver ore from the Lucky Friday mine treated in the Golconda custom mill, 4,318 tons of lead ore from the Atlas mine treated in Zanetti Bros. custom mill, and 585 tons of zinc-lead ore from the Golconda mine.

Lelande district (Burke, Mace, Frisco).—The output of the Lelande district was 136,180 tons of zinc-lead-silver ore and old tailings and 31,748 tons of lead ore in 1944 compared with 256,732 tons of zinc-lead-silver ore and old tailings, 56,217 tons of lead ore, and 50 tons of mill cleanings in 1943. The output of zinc-lead-silver ore from the Hecla mine at Burke decreased from 140,400 tons in 1943 to 26,040 tons in 1944 as production from the mine ceased in July owing to exhaustion of ore reserves. The property has been one of the principal producers of silver and lead in the State since 1902 and a large producer of zinc since 1929. According to the printed annual report of the Hecla Mining Co. for 1944, all ore remaining in the mine was worked out during the year; however, the surface facilities at Burke and the Hecla shaft will be used to service the Star mine of the Sullivan Mining Co., 50 percent of which is owned by the Hecla Mining Co. The Hecla 900-ton flotation mill was operated continuously, mainly on zinc-lead middling produced at the Osburn sink-and-float tailing plant.

A total of 54,851 tons of zinc-lead-silver ore was produced in 1944 from the Frisco mine near Gem owned by the Federal Mining & Smelting Co.; the company worked the lower levels of the mine throughout the year and hauled 30,519 tons of ore (containing an average of 1.35 ounces of silver to the ton, 3.89 percent lead, and 5.75 percent zinc) to the Morning flotation mill at Mullan, and Hull Lease worked the upper levels and treated 24,332 tons of similar ore in its own 90-ton flotation mill at Gem. According to the printed annual report of the Federal Mining & Smelting Co., the decrease in output of ore from the Frisco mine in 1944 resulted from a shortage of labor; during the year the crew lost 30 men. Ore reserves at the end of the year were estimated at 215,000 tons of developed and probable ore. From present indications, additional ore will be developed as the lower levels are made accessible.

Mining and milling at the Sherman property were continuous by the Sherman Lead Co.; however, the drop in output of lead ore from 56,217 tons in 1943 to 31,731 tons in 1944 resulted entirely from paucity of labor. The ore, milled in the company 300-ton flotation plant, contained 268,323 ounces of silver, 7,880,200 pounds of lead, and 1,492,600 pounds of zinc. According to the printed annual report of the company, no zinc concentrates were produced in 1944, as a greater economic return for zinc was secured through premium payments allowed by the quota committee of the War Production Board for zinc contained in the lead concentrates than could have been obtained in a separate mill zinc concentrate. The Sherman mine and mill are in excellent condition, and output of ore can be increased whenever additional manpower is available; full-scale operation of the mine requires not less than 125 men. Despite all efforts made by the company in cooperation with the War Manpower Commission

and the United States Employment Service, it was difficult to maintain the crew at 50.

Virtually all the remainder of the district output was old tailings (5,289 tons) deposited along Canyon Creek above Wallace and owned by the Small Leasing Co. The company reported that 36,671 tons of material, containing an average of 2.5 ounces of silver to the ton, 3.0 percent lead, and 4.5 percent zinc, were treated in the Fordosa flotation mill on the property, and 18,618 tons of similar material were hauled to the Golconda custom flotation mill for treatment.

Placer Center district.—Of the total material (185,581 tons) produced in 1944 in the Placer Center district, 124,688 tons were zinc-lead-silver ore, 32,911 tons lead-silver ore, and 27,982 tons zinc-lead old tailings. The most important output was 94,527 tons of zinc-lead-silver ore produced from the Tamarack mine by the Tamarack & Custer Consolidated Mining Co. The ore, containing 134,060 ounces of silver, 9,322,120 pounds of lead, and 13,983,740 pounds of zinc, was treated in the company 400-ton flotation mill and yielded 5,269 tons of lead-silver concentrates and 11,618 tons of zinc concentrates. According to the printed annual report of the company, the Tamarack mine and mill were operated continuously in 1944 but at a lower rate than in 1943 owing to a shortage of labor. An average crew of at least 200 men is required to maintain normal production and development. At the beginning of 1944 the company employed 169 workers, but at the end of the year the number had fallen to 115. The mine and mill are in good condition and ready for maximum production whenever manpower is available. Development was about the same in 1944 as in 1943, but not as much new ore was discovered as was extracted; hence, the ore reserves declined moderately.

The Dayrock Mining Co. operated its mine and 220-ton flotation mill continuously in 1944; a total of 32,833 tons of ore averaging 3.72 ounces of silver to the ton, 4.92 percent lead, and 0.60 percent zinc was treated in the Dayrock and Hercules milling plants and yielded 2,302 tons of high-grade silver-lead concentrates. According to the company printed annual report, the average crew at the mine in 1944 was 47 men, or about 60 percent of the working force necessary to maintain capacity production and normal development. During the year the ore reserves were increased materially by the development of rather low-grade ore (estimated at 3.3 ounces of silver to the ton and 5.4 percent lead) in the Ohio vein. It is doubtful if this new tonnage can be profitably extracted at a lead price of 6.5 cents a pound.

About 21,440 tons of zinc-lead ore were produced in 1944 from the Red Monarch, Rex, and Delaware groups near Wallace by the Callahan Consolidated Mines Co.; the ore, averaging 0.85 ounce of silver to the ton, 2.83 percent lead, and 4.54 percent zinc, was treated in the company 100-ton flotation mill. The remainder of the district output was principally 27,982 tons of zinc-lead old tailings from the Mary Jones, Tomsche, Vermillion, and Zanetti properties, 6,000 tons of zinc-lead ore from the Black Jack waste dump, and 2,141 tons of zinc-lead ore from the Success mine—all treated in custom flotation mills near Wallace.

Yreka district (Kellogg).—The output of the Yreka district in 1944 comprised 739,326 tons of zinc-lead-silver ore and old tailings, 115,281 tons of zinc slag, 47,783 tons of silver-lead-iron old tailings, and

14,850 tons of silver-lead ore—a total of 917,240 tons, the largest output in any district of Idaho and an increase of 19 percent over 1943. The most important output was 251,062 tons of zinc-lead-silver ore from the Bunker Hill & Sullivan mine at Kellogg, although its output was 30 percent less than in 1943. In addition, 7,179 tons of silver-lead ore were produced by lessees from the upper levels of the mine, and the company treated 47,783 tons of silver-lead-iron old jig tailings in a 300-ton gravity-flotation plant which yielded 5,138 tons of low-grade silver-lead-iron concentrates and 6,979 tons of high-grade iron concentrates. The company main 1,700-ton flotation mill, equipped with a sink-and-float unit, operated continuously and treated 251,062 tons of zinc-silver ore from the Bunker Hill & Sullivan mine and 215,373 tons of zinc-lead old tailings from the Sweeny dump; E. G. Smith operated a portion of the Sweeny tailing dump during the first 6 months of the year and treated about 10,000 tons of similar material in the Crescent flotation mill, which he leased. The Bunker Hill & Sullivan mine remained the largest producer of lead in Idaho and ranked third in silver and zinc. According to the company printed annual report, there were produced and recovered from Bunker Hill & Sullivan mine ore (including lessee ore) 922,716 ounces of silver, 29,655,000 pounds of lead, and 18,502,000 pounds of zinc. Because of a pronounced shortage in manpower, especially for underground mine labor, metals recovered in 1944 decreased sharply compared with 1943. There was not only a decrease in mine production but also in amount of mine development and prospecting accomplished during the year, which resulted in a slightly smaller tonnage of ore in reserve as compared with 1943, although the net tonnage remains very satisfactory. Ore reserves January 1, 1945, undercut and available for mining, totaled 2,778,539 tons of zinc-lead-silver ore. Operations at the zinc slag-fuming plant of the Bunker Hill & Sullivan Mining & Concentrating Co. at Bradley were carried on throughout the year at a much greater rate than in 1943, resulting in a 79-percent increase in production of zinc. In 1944 the plant treated 78,106 tons of old reclaimed dump slag and 76,664 tons of hot current slag from the lead furnaces of the Bunker Hill smelter at Bradley, but only the old dump slag and 37,175 tons of the hot slag were credited directly to the fuming-plant operation as a primary producer; the remainder of the hot slag was originally lead concentrates (containing zinc) shipped by various companies, chiefly in the Coeur d'Alene region, to the lead furnaces of the Bunker Hill smelter.

Mining and milling of zinc-lead-silver ore from the Blackhawk and Page mines by the Federal Mining & Smelting Co. were continuous in 1944 but at a lower rate than in 1943 owing to a shortage of miners. The company reported that 116,976 tons of ore from the Page mine and 2,223 tons of ore from the Blackhawk mine, containing an average of 4.26 ounces of silver to the ton, 7.14 percent lead, and 7.74 percent zinc, were treated in the Page 500-ton flotation mill. According to the printed annual report of the company, no shaft sinking was done during the year. On the 2,400 level of the Page mine the drift eastward on the Tony vein was driven 651 feet in 1944—the ore shoot on this level is 2,300 feet long. On the 2,100 level the drift eastward on the same vein was driven 625 feet, and the ore shoot is 1,945 feet long. The ore developed on both levels is of good average width and excellent grade. The new development has substantially increased the

reserves. Ore reserves at the end of the year were estimated at 35,000 tons of developed and probable ore—an increase of 100,000 tons over the estimated tonnage at the end of 1943.

The Highland-Surprise Consolidated Mining Co. operated its mine and mill continuously; the 150-ton flotation mill treated 34,857 tons of zinc-lead ore (18,130 tons in 1943), yielding 5,436 tons of zinc-lead concentrates. In 1944 the capacity of the 100-ton flotation mill at the Little Pittsburg property was increased to 125 tons of ore a day by the Denver Development Co.; during the year the mill treated 354 tons of zinc-lead ore yielding 5,754 tons of zinc-lead concentrates. Mining and milling were continued throughout the year at the Douglas mine on Pine Creek by the Small Leasing Co.; the company 100-ton flotation mill treated 23,608 tons of zinc-lead ore yielding 3,538 tons of zinc-lead concentrates. Late in the year the Spokane-Idaho Mining Co. changed its milling practice from producing a bulk zinc-lead concentrate to producing two products—a high-grade lead concentrate and a zinc-lead concentrate. During the year the company 150-ton flotation mill treated 22,246 tons of zinc-lead ore yielding 3,807 tons of zinc-lead concentrates and 182 tons of high-grade lead concentrates. The Nabob mine on Denver Creek was taken over in January 1944 under lease by the Lynch-Pine Creek Mining Co.; during the year this company hauled 16,248 tons of zinc-lead ore to the Amy Matchless flotation mill on Pine Creek, where the ore was beneficiated to 534 tons of lead concentrates and 1,491 tons of zinc concentrates. The Sidney mine, also on Denver Creek, was operated continuously in 1944 by the Sidney Mining Co. The company reported that 12,215 tons of zinc-lead ore were treated in its 50-ton flotation mill and that diamond drilling by the Bureau of Mines and underground development by the Sidney Mining Co. opened an extensive body of zinc-lead ore. The rest of the district output was principally 7,671 tons of silver-lead ore produced from the Liberal King mine by Sunset Mineral, Inc., and treated by flotation.

VALLEY COUNTY

Deadwood Basin district.—The Callahan Zinc-Lead Co. operated the Hall-Interstate property and its 100-ton flotation mill at Deadwood continuously in 1944. According to the company printed annual report, only 5,263 tons of zinc-lead-silver ore were milled during the first 8 months of the year, as the time was devoted primarily to development. Productive operations were resumed in September, and during the rest of the year the mill treated 10,525 tons of zinc-lead-silver ore.

Yellow Pine district.—The capacity of the Yellow Pine mill at Subnite was increased to 800 tons of ore a day in 1944, and during the year 211,382 tons of gold-silver-iron-antimony-tungsten ore, taken from an open pit at the mine, were treated by flotation. The mill yielded 3,573 tons of high-grade tungsten concentrates, 8,807 tons of low-grade tungsten concentrates, 6,975 tons of antimony-silver-gold concentrates, and 4,103 tons of gold-silver-antimony-iron concentrates. The property was the largest producer of gold, antimony, and tungsten in Idaho in 1944.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA

(MINE REPORT)

By G. E. WOODWARD AND PAUL LUFF

SUMMARY OUTLINE

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SUMMARY

Copper ore remained the chief source of metal value in Montana in 1944; the value of the metals recovered from copper ore and its products was \$35,998,281 or 73 percent of the State total. The total value of the gold, silver, copper, lead, and zinc produced from Montana ores and gravels was, in terms of recovered metals, \$49,039,855, compared with \$53,642,658 in 1943. (See fig. 1.) This 9-percent decrease resulted from a smaller output of each metal; however, the value of the zinc output was greater owing to the higher average price of the metal. The total value (\$1,750,735) of the gold output declined 16 percent; silver (\$5,044,064), 16 percent; copper (\$31,911,300), 9 percent; and lead (\$2,096,800), 14 percent. The value (\$8,236,956) of the zinc output increased 1 percent. Silver Bow County, which yielded virtually all the copper output of the State and most of the silver, produced gold, silver, copper, lead, and zinc valued at \$38,877,303, compared with \$42,100,656 in 1943. The decrease resulted from a smaller output of gold, silver, and copper, as the yield of lead and zinc was greater.

Production of gold, silver, copper, lead, and zinc in Montana in 1944 was affected by several factors: An acute shortage of labor which was the primary cause of a loss in output of gold, silver, and copper; the marked decrease in output of direct-smelting copper ore from mines at Butte; the suspension in May of mining siliceous silver ore at the Flathead mine near Kila; the permanent shut-down in April of the Perry-Schroeder bucket dredge near Helena; the closing in September of the Boaz gold mine at Norris; the beginning in February of milling gold-arsenic ore at the Jardine property at Jardine; and the decrease in treatment of zinc slag and zinc-lead ore.

Considerable assistance was given to mine operators in Montana in 1944 by the Grazing and Forest Services through the building of access roads to various properties. Most of the roads approved for construction were to zinc-lead properties in Cascade, Gallatin, Lincoln, Powell, and Sanders Counties; roads were constructed also to a copper deposit in Beaverhead County, a lead deposit in Meagher County, an antimony deposit in Sanders County, mica deposits in Madison County, corundum deposits in Gallatin County, a barite deposit in Missoula County, and coal mines in Chouteau, Madison, and Rosebud Counties. The Bureau of Mines, in cooperation with the Geological

Survey, did considerable work in 1944, exploring and testing various properties throughout the State. Most of this work was drilling test holes at the Running Wolf iron deposits in Judith Basin County, Sheep Creek iron deposit in Meagher County, Southern Cross iron deposit in Deer Lodge County, corundum deposits in Gallatin and Madison Counties, optical calcite deposits in Sweet Grass County, Johnny Gulch talc deposit in Madison County, zinc-lead mines in Cascade and Madison Counties, and copper deposits in Granite, Madison, and Silver Bow Counties.

The ceiling prices of copper, lead, and zinc have not changed since February 1942; copper has been 12 cents a pound, lead 6½ cents (New York), and zinc 8½ cents. To augment the prices for these metals the Government policy of premium payments for overquota production of copper, lead, and zinc remained in force throughout 1944.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ³	Zinc ³
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940.....	\$35.00	\$0.711+	\$0.113	\$0.050	\$0.063
1941.....	35.00	0.711+	.118	.057	.075
1942.....	35.00	0.711+	.121	.067	.093
1943.....	35.00	0.711+	.130	.075	.108
1944.....	35.00	0.711+	.135	.080	.114

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1937, to Jan. 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price of bonus payments by Metals Reserve Company for overquota production.

⁴ Minimum.

Mine production of gold, silver, copper, lead, and zinc in Montana, 1940-44, and total, 1882-1944, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1940.....	687	285	5,099,241	272,602	\$9,541,070	12,361,050	\$8,790,090
1941.....	612	325	5,642,249	248,475	8,626,625	12,386,925	8,808,480
1942.....	370	170	5,678,280	146,892	5,141,220	11,188,118	7,955,995
1943.....	227	45	5,873,016	59,586	2,085,510	8,450,370	6,009,152
1944.....	188	24	6,049,462	50,021	1,750,735	7,093,215	5,044,064
1942-1944.....			(¹)	16,937,017	377,248,807	739,934,613	540,205,883

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1940.....	252,782,000	\$28,564,366	46,072,000	\$2,303,600	105,174,000	\$6,625,962	\$55,825,078
1941.....	256,072,000	30,216,496	42,518,000	2,423,526	121,420,000	9,106,500	59,181,627
1942.....	282,388,000	34,168,948	40,100,000	2,686,700	109,430,000	10,176,990	60,129,853
1943.....	269,050,000	34,976,500	32,648,000	2,448,600	75,212,000	8,122,896	53,642,658
1944.....	236,380,000	31,911,300	26,210,000	2,096,800	72,254,000	8,236,956	49,039,855
1942-1944.....	\$6,431,366	1,858,956,210	\$676,721	73,739,768	\$1,828,115	281,328,272	3,131,478,940

¹ Figures not available.

² Short tons.

Gold and silver produced at placer mines in Montana, 1940-44, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Drift mining		Dredges						Total	
					Dry-land ¹		Dragline floating ¹		Floating bucket			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1940.....	2,163	272	281	41	11,252	2,640	11,439	1,302	39,012	7,400	64,147	11,654
1941.....	2,306	353	139	17	14,663	2,406	10,660	833	33,844	6,424	61,611	10,031
1942.....	2,732	356	-----	-----	3,674	434	3,553	407	31,283	5,740	41,242	6,937
1943.....	486	51	7	-----	-----	-----	-----	-----	13,579	1,299	14,072	1,350
1944.....	334	45	2	-----	-----	-----	-----	-----	5,887	450	6,223	490

¹ Floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

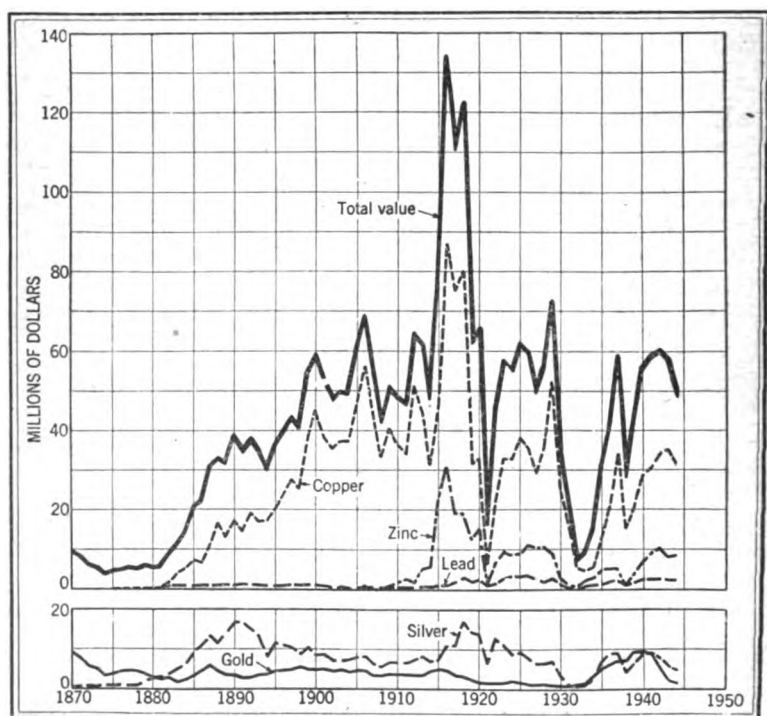


FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Montana, 1870-1944.

Gold.—Montana ores and gravels yielded 50,021 fine ounces of gold in 1944, compared with 59,586 ounces in 1943—a 16-percent decrease; the output from lode mines decreased 1,716 ounces and from placer mines 7,849 ounces. Marked decreases in gold output at the Boaz mine and the Perry-Schroeder bucket dredge more than offset a substantial increase at the Jardine mine. War Production Limitation

Order L-208 restricting production from gold mines remained in effect throughout 1944; however, grants for continuation of operation were extended to four producers in Montana in 1944. These mines justified their operation by reason of supplying a special product to the Government or smelters or because exhaustion of the mineral deposits was near completion. Siliceous ores (chiefly gold ore) yielded 51 percent of the State total gold, base-metal ores (mainly copper ore and zinc-lead ore) 36 percent, and placers 13 percent. Gold recovered from gold ore and base-metal ores was virtually the same as in 1943, but gold from siliceous silver ore declined 1,426 ounces. More than 85 percent of the State total gold came from properties in the Summit Valley (Butte), Sheepeater (Jardine), Whitehall, New World (Cooke City), Henderson, Flint Creek (Philipsburg), Missouri River, Marysville, and Norris districts. Gold ore mined totaled 97,928 tons, compared with 72,616 tons in 1943, and comprised 50,935 tons treated in amalgamation and cyanidation mills, 21,352 tons in concentrating mills, and 25,641 tons shipped crude to smelters. Ore treated at amalgamation and cyanidation mills (with or without concentrating equipment) yielded more than 14 percent of the State total gold; ore concentrated, 40 percent; and ore of all classes shipped crude to smelters, 33 percent. Two floating connected-bucket dredges were active in 1944; however, one of these—Perry-Schroeder 6-cubic foot (90-bucket) dredge on the Missouri River in Lewis and Clark County—ceased operations April 12, 1944, owing to exhaustion of profitable gravel. The other (H. & H. Mines 3½-cubic foot bucket dredge on Henderson Creek in Granite County) remained in operation through December and is still operating in 1945, because this dredge recovers tungsten in addition to gold.

The leading gold producers in Montana in 1944 were: All the company-operated copper mines, waste dumps, tailing dumps, and slime ponds of the Anaconda Copper Mining Co. at Butte and Anaconda; the Jardine mine at Jardine; the Golden Sunlight mine near Whitehall; the Estelle mine at Cooke City; the H. & H. dredge near Hall; the Granite-Bimetallic tailing dump at Philipsburg; the Perry-Schroeder dredge near Helena; and the Boaz mine at Norris.

Silver.—The output of recoverable silver in Montana was 7,093,215 fine ounces in 1944 compared with 8,450,370 ounces in 1943—a 16-percent decrease. The principal decreases were in the Summit Valley (Butte), Hog Heaven, Barker, Montana, Elkhorn, Colorado, and Heddlleston districts. Ore treated at concentrating mills yielded 88 percent of the total silver and smelting ore 11 percent; the remainder came largely from slag fumed. Copper ore yielded 78 percent of the State total silver; zinc-lead ore 11 percent; siliceous ores 9 percent; and lead ore and zinc ore 2 percent. The output of silver from siliceous silver ore declined 692,950 ounces, that from copper ore 497,540 ounces, that from zinc-lead ore 195,983 ounces, and that from lead ore 15,598 ounces, but silver from zinc ore and slag increased 34,537 ounces.

Copper mines, mine dumps, tailing dumps, slime ponds, and zinc mines and the North Butte property (all at either Butte or Anaconda) and the Flathead mine (in Flathead County)—all operated by the Anaconda Copper Mining Co.—produced 79 percent of the State total silver in 1944. Other large producers included the Emma mine at Butte (all byproduct silver), the Granite-Bimetallic tailing dump at Philipsburg, and the Mike Horse mine near Flesher in Lewis and Clark County.

Copper.—Copper produced in Montana, in terms of recovered metal, was 236,380,000 pounds in 1944 compared with 269,050,000 pounds in 1943—a 12-percent decrease. The Anaconda Copper Mining Co. was the only important copper producer in Montana and contributed 99 percent of the State copper output. The company treated a greater tonnage of copper material than in 1943; the lower copper content resulted from the treatment of more old tailings and slime ponds. All the copper mines at Butte are owned or operated by the Anaconda Copper Mining Co. Copper produced from mine ore at Butte decreased, but that derived from the treatment of mine dumps at Butte and old tailing dumps and slime ponds at Anaconda increased. Virtually all the waste materials at Anaconda were derived from the earlier treatment of ore from copper mines at Butte.

Lead and zinc.—The output of recoverable lead in Montana in 1944 was 26,210,000 pounds—a 20-percent decrease from 1943, and the output of recoverable zinc was 72,254,000 pounds—a 4-percent decrease. The slag-fuming plant at East Helena, operated by the Anaconda Copper Mining Co., showed a decrease of about 2,175,000 pounds in lead and 8,170,000 pounds in zinc. The Emma mine at Butte, operated by the Anaconda Copper Mining Co. under lease, showed a decrease of about 1,225,000 pounds in byproduct lead and about 531,000 pounds in zinc; no zinc-lead ore was mined from this property in 1944. About 70 percent of the State lead output was recovered from zinc-lead ore, 11 percent from zinc ore and slag, 10 percent from lead ore, and 9 percent from siliceous ores.

The leading sources of zinc in 1944, named in order of output, were the slag-fuming plant at East Helena (about 56 percent of the State total), the Emma byproduct zinc, the Poulin mine at Butte, the Mike Horse mine near Flesher, the Silver Cable mine near Saltese, the Toledo-Buckeye group near Sheridan, and the Mount Washington mine at Wickes. About 59 percent of the State zinc output was recovered from zinc ore and slag and nearly all the remainder from zinc-lead ore.

The leading producers of lead in 1944 were the Mike Horse, the Emma byproduct lead, the slag-fuming plant at East Helena, the Jack Waite, Poulin, and Mount Washington properties, and the Hecla slag dump; these seven sources contributed more than 62 percent of the State total.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Montana in 1944 by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Beaverhead.....	9	1	614	\$21,490	50,850	\$36,160
Bradwater.....	18		703	24,605	51,345	36,512
Cascade.....	7		384	13,440	93,915	66,784
Fergus.....	1	1	6	210		
Flathead.....	2		149	5,215	93,330	66,368
Gallatin.....		1	1	35		
Granite.....	12	4	6,413	224,455	275,760	196,096
Jefferson.....	37		7,170	250,950	159,300	113,280
Johns Basin.....	3		24	840	1,845	1,312
Lewis and Clark.....	20	4	4,730	165,550	230,535	163,936
Lincoln.....	4	2	170	5,950	5,490	3,904
Madison.....	28	1	2,794	97,790	63,765	45,344
Meagher.....	1	1	3	105	810	576
Mineral.....	2		19	665	19,890	14,144
Mussula.....	4	4	119	4,165	1,125	800
Park.....	3	2	11,010	385,350	24,075	17,120
Phillips.....	1		14	490	135	96
Powell.....	6	2	97	3,395	4,365	3,104
Ravalli.....	1		110	3,850	4,185	2,976
Sanders.....	3		28	980	10,800	7,680
Silver Bow.....	26	1	15,463	541,205	6,001,695	4,267,872
Total, 1943.....	188	24	50,021	1,750,735	7,093,215	5,044,064
	227	45	59,586	2,085,510	8,450,370	6,009,152

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaverhead.....	105,800	\$14,283	1,210,700	\$96,856	731,500	\$83,391	\$252,180
Bradwater.....	16,400	2,214	944,400	75,552	1,016,000	115,824	254,707
Cascade.....	18,800	2,538	1,223,800	97,904	1,699,500	193,743	374,409
Fergus.....	5,400	729					939
Flathead.....	62,200	8,397	1,500	120	3,500	399	80,499
Gallatin.....							35
Granite.....	244,000	32,940	768,500	61,480	928,000	105,792	620,763
Jefferson.....	66,000	8,910	1,979,200	158,336	1,599,000	182,286	713,762
Johns Basin.....	2,000	270	27,600	2,208			4,630
Lewis and Clark.....	598,400	80,784	8,511,100	680,888	44,313,500	5,051,739	6,142,897
Lincoln.....	2,400	324	222,400	17,792	236,500	26,961	54,931
Madison.....	203,000	27,405	1,203,700	96,296	2,313,000	263,682	530,517
Meagher.....			44,300	3,544			4,225
Mineral.....	39,800	5,373	914,800	73,184	2,817,500	321,195	414,561
Mussula.....	8,400	1,134					6,099
Park.....	200,800	27,108	106,400	8,672	85,000	9,690	447,940
Phillips.....							586
Powell.....	1,600	216	71,700	5,736	59,000	6,726	19,177
Ravalli.....	13,800	1,863	26,800	2,144	95,000	10,830	21,663
Sanders.....	59,000	7,965	2,256,100	180,488	183,500	20,919	218,032
Silver Bow.....	234,732,200	31,688,847	6,695,000	535,600	16,173,500	1,843,779	38,877,303
Total, 1943.....	236,380,000	31,911,300	26,210,000	2,096,800	72,254,000	8,236,956	49,039,855
	269,050,000	34,976,500	32,648,000	2,448,600	75,212,000	8,122,896	53,642,658

Gold and silver produced at lode mines in Montana in 1944, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Beaverhead.....	10,665	426	50,805	Mineral.....	12,589	19	19,890
Broadwater.....	10,926	703	51,345	Missoula.....	277	102	1,125
Cascade.....	48,274	384	93,915	Park.....	72,408	11,004	24,075
Fergus.....	47			Phillips.....	3	14	135
Flathead.....	3,220	149	93,330	Powell.....	1,572	39	4,365
Granite.....	75,182	2,801	275,535	Ravalli.....	4,170	110	4,185
Jefferson.....	47,240	7,170	159,300	Sanders.....	10,189	28	10,800
Judith Basin.....	100	24	1,845	Silver Bow.....	5,429,931	15,461	6,001,695
Lewis and Clark.....	276,266	2,413	230,310				
Lincoln.....	5,336	159	5,490		6,049,462	43,798	7,092,720
Madison.....	40,959	2,792	63,765		5,873,016	45,514	8,449,020
Meagher.....	106		810	Total, 1943.....			

Gold and silver produced at placer mines in Montana in 1944, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Floating bucket dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Beaverhead.....	188	45					188	45
Fergus.....	6						6	
Gallatin.....	1						1	
Granite.....	30				3,582	225	3,612	225
Lewis and Clark.....	10		2		2,305	225	2,317	225
Lincoln.....	11						11	
Madison.....	2						2	
Meagher.....	3						3	
Missoula.....	17						17	
Park.....	6						6	
Powell.....	58						58	
Silver Bow.....	2						2	
Total, 1943.....	334	45	2		5,887	450	6,223	495
	486	51	7		13,579	1,299	14,072	1,350

MINING INDUSTRY

In spite of a serious labor shortage throughout the various mining districts in Montana in 1944, the total ore, old tailings, and slag mined or treated was greater than in 1943; however, the output of each metal (gold, silver, copper, lead, and zinc) was less. Copper ore mined at Butte declined from 3,377,318 to 2,559,796 tons, but waste-dump ore increased from 492,673 to 879,879 tons and old tailings and slimes mined at Anaconda increased from 1,243,133 to 1,906,626 tons. The State output of zinc-lead ore (mined principally in the Butte, Heddleston, Sheridan, Montana (Neihart), Dunkleberg, and Colorado (Wickes) districts) declined from 294,369 to 258,874 tons, zinc ore and slag from 234,361 to 201,470 tons, and silver ore from 140,466 to 65,317 tons; gold ore (mined principally in the Sheep-eater, New World, and Whitehall districts) increased from 72,616 to 97,928 tons, gold-silver ore (largely old tailings mined from a property in the Flint Creek district) from 53,890 to 68,154 tons, and lead ore from 8,449 to 16,857 tons.

Two connected-bucket floating dredges were active in Montana in 1944—one near Hall in Granite County and the other near Helena in Lewis and Clark County. They treated 1,197,600 cubic yards of gravel and recovered gold valued at \$206,045, indicating an average recoverable gold value of 17 cents per cubic yard treated. No dragline floating or dry-land dredges were active in Montana in 1944.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Montana in 1944, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore.....	52	97,928	21,438	24,634	347,625	76,031	-----
Dry and siliceous gold-silver ore.....	15	68,154	3,412	280,102	212,716	481,492	117,065
Dry and siliceous silver ore.....	36	66,317	790	313,648	319,270	1,758,856	90,562
-----	103	231,399	25,640	618,384	879,610	2,316,379	207,627
Copper ore.....	14	5,340,862	13,183	5,515,288	234,184,501	-----	-----
Silver ore.....	39	16,857	928	66,283	71,998	2,699,242	81,232
Lead ore.....	10	1201,470	35	79,812	19,761	2,860,228	42,460,357
Zinc-lead ore.....	38	258,874	4,014	812,873	1,224,130	18,334,150	29,504,784
Total, lode mines.....	*188	6,049,462	43,798	7,092,720	236,380,000	26,210,000	72,254,000
Total placers.....	24	-----	6,223	495	-----	-----	-----
-----	212	6,049,462	50,021	7,093,215	236,380,000	26,210,000	72,254,000
Total, 1943.....	272	5,873,016	59,586	8,450,370	*269,050,000	32,648,000	75,212,000

*Includes 4,713,664 pounds recovered from precipitates.

†Includes 187,988 tons of current slag fumed.

‡A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

§Includes 4,369,199 pounds recovered from precipitates.

METALLURGIC INDUSTRY

The 6,049,462 tons of ore produced from Montana lode mines in 1944 were treated as follows: 505 tons at amalgamation mills, 50,430 tons at amalgamation-cyanidation-concentration mills, 5,569,756 tons at concentrating mills, 240,783 tons shipped to smelters, and 187,988 tons of slag fumed.

One amalgamation-cyanide-concentration mill at Jardine, Park County, was active in Montana in 1944; it reported that 50,430 tons of gold-arsenic ore were treated, consuming 228 pounds of quicksilver, 34,000 pounds of calcium cyanide, 1,600 pounds of zinc dust, and 42,500 pounds of lime. The ore contained 10,641 ounces of gold and some silver and arsenic; the calcines and concentrates, containing principally gold, were shipped to smelters, gold bullion was sold to the United States Assay Office at Seattle, Wash., and arsenic trioxide was sold to the Government.

A total of 5,569,756 tons of ore of all classes was treated in straight concentration plants, compared with 5,327,448 tons in 1943. The 1944 total comprised 42,981 tons of siliceous ores, 5,272,359 tons of copper ore, 8,713 tons of lead ore, 2,666 tons of zinc ore, and 243,037 tons of zinc-lead ore.

The Anaconda Copper Mining Co. operated its electrolytic zinc plants at Anaconda and Great Falls without interruption in 1944. The Anaconda section had 5 units and the Great Falls section 10 units. The total rated capacity of the 15 units is 245,000 tons of slab zinc per year. In 1944 the average unit production of slab zinc per month was about 2,495,000 pounds, and, in addition, zinc dross was produced at a rate of about 46,000 pounds of contained zinc per unit per month, or a total of 2,541,000 pounds of zinc per month. The dross was sold to other plants for their use. Zinc concentrates were received and treated from most of the Western States, but chiefly from Idaho, Utah, Montana, Washington, Nevada, New Mexico, and California. In addition to domestic concentrates treated, the Anaconda and Great Falls plants treated about 210,000 tons of zinc concentrates from foreign sources, chiefly upon a toll basis, for accounts of the Metals Reserve Company. These concentrates originated from mines in Canada, Mexico, Peru, Chile, and Australia, as follows (quantities approximate): Canada, 50,000 tons; Mexico, 82,000 tons; Peru, 10,000 tons; Chile, 19,000 tons; and Australia, 49,000 tons. At Anaconda the copper smelter operated continuously. The company has 3 concentrating units at Anaconda—a copper concentrator with a daily rated capacity of 12,320 tons of ore, a zinc concentrator with a daily rated capacity of 2,000 tons, and a slime-disintegrating plant with a daily rated capacity of 2,000 tons. The copper concentrator is divided into 2 mills—the west mill and the east mill; the west mill has 3 identical sections, and the east mill has 4 sections; both mills treated only copper material in 1944. The zinc concentrator treated sulfide concentrates from manganese ores; the crushing, grinding, and some flotation equipment was used for treatment of copper mine dumps from Butte. The slime-disintegrating plant treats slime deposits. The American Smelting & Refining Co. operated its lead smelter at East Helena continuously in 1944, except for a brief period in May when the plant was shut down, principally for repairing and cleaning the flue systems.

Details of the treatment of all ores produced in Montana in 1944 are given in the tables that follow.

Mine production of metals in Montana in 1944, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated.....	505	137	9			
Ore cyanided.....	50,430	5,879	1,520			
Concentrates smelted.....	531,226	21,386	6,248,171	226,002,399	17,287,417	27,540,393
Copper precipitates smelted.....	3,832			4,713,664		
Ore smelted.....	240,783	16,396	812,269	5,663,937	6,502,408	4,553,107
Slag fused.....	187,988		30,745		2,420,175	40,160,500
Placer.....		6,223	495			
Total, 1943.....		50,021	7,093,215	236,380,000	26,210,000	72,254,000
		59,586	8,450,370	269,050,000	32,648,000	76,212,000

¹ Includes zinc concentrates treated at electrolytic plants.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Montana in 1944, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal				
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Beaverhead	10	2						
Broadwater	412	117	6	3	4			
Cascade	70	2	1	1	1	20		783
Chouteau	5	6	1					
Deer Lodge	5	5	1					
Flint	3	5						
Total, 1943	505 3,346	137 273	9 18	4 143	5 367	20 3,373		783 423

CYANIDATION MILLS

Part	50,430	5,879	1,526	693	1,264	416		
Total, 1943	50,430 31,580	5,879 4,824	1,526 1,560	693 2,397	1,264 4,269	416 1,663	2,535	33,358
Grand total: 1944 1943	50,935 34,926	6,016 5,097	1,535 1,578	697 2,540	1,269 4,636	436 5,036	2,535	783 33,781

Mine production of metals from concentrating mills in Montana in 1944, by counties, in terms of recovered metals

County	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaverhead	31	23		128	260	8,595	5,000
Broadwater	4,130	650	208	9,592	4,078	168,729	120,022
Cascade	48,272	3,134	384	93,890	18,800	1,223,800	1,699,500
Chouteau	18,529	1,319	25	37,502	32,817	470,987	857,767
Deer Lodge	6,751	445	36	7,830	5,347	156,233	232,637
Flint and Clark	63,538	7,961	200	168,974	537,927	5,362,738	3,060,198
Golden	4,992	470	114	4,070	2,026	150,978	191,504
Missouri	32,890	2,964	407	32,592	60,589	825,961	2,118,127
Mineral	12,589	3,392	19	19,890	39,800	914,800	2,817,500
Park	21,852	893	3,860	15,935	200,600	64,864	58,138
Phillips	1,553	144	26	4,256	1,000	69,426	59,000
Richmond	4,170	186	110	4,185	13,800	26,800	95,000
Silver Bow	9,770	1,648	16	9,435	22,017	2,006,177	183,500
Total, 1943	5,340,689	507,400	14,712	5,839,456	225,063,338	5,836,546	16,042,600
Total, 1944	5,569,756 5,327,448	530,529 582,916	20,117 18,833	6,247,735 7,113,547	226,002,399 257,816,385	17,286,634 22,196,364	27,540,393 25,907,192

Gross metal content of concentrates produced from ore mined in Montana in 1944, by classes of concentrates smelted

Class of concentrates	Concentrates (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold.....	696	1,268	416	728	-----	4,288
Copper.....	484,838	16,543	5,452,875	227,480,564	-----	-----
Lead.....	8,307	885	250,197	338,822	9,486,034	1,345,653
Lead-copper.....	4,727	251	153,817	496,435	4,767,794	741,229
Zinc.....	8,982	352	69,898	184,589	399,088	9,026,031
Zinc-lead.....	21,666	1,986	311,176	324,335	3,041,886	18,909,725
Dry iron (from zinc-lead ore)...	2,010	107	10,940	31,119	143,111	428,044
Total, 1943.....	531,226	21,392	6,249,319	228,856,592	17,837,913	30,454,970
	585,456	23,493	7,123,929	259,754,211	23,374,669	30,766,411

Mine production of metals from Montana concentrates shipped to smelters in 1944, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaverhead.....	23	-----	128	260	8,595	5,000
Broadwater.....	653	212	9,592	4,078	168,729	120,022
Cascade.....	3,134	384	93,890	18,800	1,223,800	1,699,500
Granite.....	1,319	25	37,502	32,817	470,987	857,767
Jefferson.....	446	37	7,850	5,347	157,016	232,637
Lewis and Clark.....	7,961	200	168,974	537,927	5,362,738	3,060,198
Lincoln.....	470	114	4,070	2,026	150,978	191,504
Madison.....	2,964	407	32,562	60,589	825,961	2,118,127
Mineral.....	3,392	19	19,890	39,800	914,800	2,817,500
Park.....	1,586	5,124	16,351	200,600	64,864	58,138
Powell.....	144	26	4,256	1,000	69,426	59,000
Ravalli.....	186	110	4,185	13,800	26,800	95,000
Sanders.....	1,543	16	9,435	22,017	2,006,177	183,500
Silver Bow.....	507,400	14,712	5,839,456	225,063,338	5,836,546	16,042,500
Total, 1943.....	531,226	21,386	6,248,171	226,002,399	17,287,417	27,540,393
	585,456	23,469	7,118,583	257,818,920	22,230,145	25,907,192

BY CLASSES OF CONCENTRATES

Dry gold.....	696	1,268	416	-----	-----	-----
Copper.....	484,838	16,543	5,452,875	224,784,981	-----	-----
Lead.....	8,307	885	250,197	287,136	9,269,398	929,543
Lead-copper.....	4,727	251	153,817	421,842	4,705,783	603,310
Zinc.....	8,982	346	68,750	174,946	358,276	8,120,608
Zinc-lead.....	21,666	1,986	311,176	307,227	2,818,444	17,886,932
Dry iron (from zinc-lead ore)...	2,010	107	10,940	26,287	135,516	-----
Total, 1943.....	531,226	21,386	6,248,171	226,002,399	17,287,417	27,540,393

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA 375

Gross metal content of Montana crude ore shipped to smelters in 1944, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold.....	25, 641	10, 296	17, 680	153, 400	80, 831	-----
Dry and siliceous gold-silver.....	60, 586	3, 159	265, 831	205, 180	670, 264	1, 539
Dry and siliceous silver.....	51, 256	736	293, 804	872, 987	1, 675, 708	2, 867, 434
Copper.....	68, 503	497	67, 376	4, 943, 162	-----	-----
Lead.....	8, 144	739	52, 827	35, 568	2, 035, 309	4, 903
zinc.....	10, 816	14	30, 103	3, 414	422, 069	2, 549, 908
zinc-lead.....	15, 837	955	84, 648	98, 104	2, 076, 755	3, 347, 301
Total, 1943.....	240, 783	16, 396	812, 269	5, 811, 815	6, 960, 436	8, 771, 085
	285, 381	16, 948	1, 295, 298	7, 267, 236	6, 171, 457	1, 578, 829

Mine production of metals from Montana crude ore shipped to smelters in 1944, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaverhead.....	10, 624	424	50, 677	105, 540	1, 202, 105	726, 500
Broadwater.....	6, 384	374	41, 747	12, 322	775, 671	895, 978
Cascade.....	2	-----	25	-----	-----	-----
Fergus.....	47	-----	-----	5, 400	-----	-----
Flathead.....	3, 220	149	93, 330	62, 200	1, 500	3, 500
Groenle.....	56, 653	2, 776	238, 033	211, 183	297, 513	70, 233
Jefferson.....	40, 419	7, 131	151, 449	60, 653	1, 822, 184	1, 366, 363
Judith Basin.....	100	24	1, 845	2, 000	27, 600	-----
Levi and Clark.....	24, 740	2, 213	30, 591	60, 473	728, 187	1, 092, 802
Lincoln.....	339	39	1, 419	374	71, 422	44, 996
Madison.....	8, 064	2, 380	31, 172	142, 411	377, 739	194, 873
Marguerite.....	108	-----	810	-----	44, 300	-----
Minerals.....	277	102	1, 125	8, 400	-----	-----
Park.....	126	1	6, 198	200	43, 536	26, 862
Phillips.....	3	14	135	-----	-----	-----
Powell.....	16	8	109	600	2, 274	-----
Sanders.....	419	12	1, 365	36, 983	249, 923	-----
Silver Bow.....	89, 242	749	162, 239	4, 955, 198	858, 454	131, 000
Total, 1943.....	240, 783	16, 396	812, 269	5, 663, 937	6, 502, 408	4, 553, 107
	285, 381	16, 948	1, 295, 298	6, 861, 881	5, 822, 044	974, 808

BY CLASSES OF ORE

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold.....	25, 641	10, 296	17, 680	147, 768	75, 248	-----
Dry and siliceous gold-silver.....	60, 586	3, 159	265, 831	198, 520	443, 166	-----
Dry and siliceous silver.....	51, 256	736	293, 804	318, 073	1, 569, 287	3, 500
Copper.....	68, 503	497	67, 376	4, 885, 713	-----	-----
Lead.....	8, 144	739	52, 827	27, 656	1, 953, 989	664
zinc.....	10, 816	14	30, 103	2, 813	415, 740	1, 939, 833
zinc-lead.....	15, 837	955	84, 648	83, 394	2, 044, 978	2, 609, 110
Total, 1943.....	240, 783	16, 396	812, 269	5, 663, 937	6, 502, 408	4, 553, 107

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Montana in 1944, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Beaverhead County:	3		1,398	50		50	2,506		2,506	7,200	358,200	5,000	\$33,730
Argenta.....	1		63	51		51							1,785
Bannack.....	1		8,336	312		312	35,325		35,325	96,400	847,600	726,500	199,683
Bryant.....	1	1	24		188	188	59	45			4,900		7,046
Horse Prairie Creek or Colorado.	3		844	13		13	12,915		12,915	2,200			9,936
Vipond.....													
Broadwater County:													
Baker.....	1		10	5		5							175
Beaver.....	6		3,799	419		419	19,440		19,440	10,400	341,800	85,000	66,927
Cedar Plains.....	5		731	18		18	4,261		4,261	3,600	176,000	82,500	27,631
Clasall.....	1		14	4		4	21		21		400		27,187
Park or Indian Creek.....	5		6,372	257		257	27,623		27,623	2,400	426,200	848,500	159,787
Cascade County:													
Barker.....	1		525	4		4	2,506		2,506	600	85,300	190,500	30,544
Montana.....	6		47,749	380		380	91,409		91,409	18,200	1,138,500	1,509,000	343,865
Fergus County:													
Cone Butte.....	1		47							5,400			729
North Meccasin.....	2	1	3,220	149	6	149	93,330		93,330	62,200	1,500	3,500	80,499
Flathead County: Hog Heaven													35
Gallatin County: Eldridge													
Granite County:													
Boulder and South Boulder.....	1	1	16	6	1	7	3,323		3,323	600	4,300		3,033
Dunkleberg.....	1		17,171	7		7	21,683		21,683	30,800	471,300	694,500	136,699
First Chance.....	3	2	814	40	29	69	1,388		1,388	12,800			5,130
Flint Creek.....	7		57,181	2,748		2,748	249,141		249,141	190,800	292,900	233,500	350,371
Hendersson.....		1			3,582	3,582		225	225				125,530
Jefferson County:													
Boulder and Little Boulder.....	1		674	20		20	5,625		5,625	3,800	21,000		6,893
Catareac.....	15		2,013	265		265	12,714		12,714	4,200	118,900	39,500	32,898
Clancy.....	2		13										
Colorado.....	6		17,249	917		917	64,682		64,682	27,000	1,043,500	1,559,000	342,942
Elkhorn.....	2		10,454	270		270	68,670		68,670	8,400	373,900		89,328
Galconda.....	1		23	3		3	367		367	1,600			90
Mitchell.....	1		21	41		41	90		90		400		1,499
Warm Springs.....	7		7	28		28							62
Whitetail.....	7		16,705	5,406		5,406	6,138		6,138	19,600	416,600		229,563
Wilson and Ticer Creeks.....	1		81	248		248	855		855	1,400	4,700		9,853

Judith Basin Counties:		Park County:		Beaver County:		Lincoln County:		Madison County:		McCarthy County:		Nevada County:		Packer County:		Phillips County:		Powell County:		Sagehen County:		Teton County:		Yellowstone County:		Gallatin County:		Blaine County:		Custer County:		Fergus County:		Glacier County:		Granite County:		Harrison County:		Jefferson County:		Liberty County:		Mussouri County:		Park County:		Ponderosa County:		Reno County:		Sheridan County:		Teton County:		Yellowstone County:		Gallatin County:		Blaine County:		Custer County:		Fergus County:		Glacier County:		Granite County:		Harrison County:		Jefferson County:		Liberty County:		Mussouri County:		Park County:		Ponderosa County:		Reno County:		Sheridan County:		Teton County:		Yellowstone County:		Gallatin County:		Blaine County:		Custer County:		Fergus County:		Glacier County:		Granite County:		Harrison County:		Jefferson County:		Liberty County:		Mussouri County:		Park County:		Ponderosa County:		Reno County:		Sheridan County:		Teton County:		Yellowstone County:		Gallatin County:		Blaine County:		Custer County:		Fergus County:		Glacier County:		Granite County:		Harrison County:		Jefferson County:		Liberty County:		Mussouri County:		Park County:		Ponderosa County:		Reno County:		Sheridan County:		Teton County:		Yellowstone County:		Gallatin County:		Blaine County:		Custer County:		Fergus County:		Glacier County:		Granite County:		Harrison County:		Jefferson County:		Liberty County:		Mussouri County:		Park County:		Ponderosa County:		Reno County:		Sheridan County:		Teton County:		Yellowstone County:		Gallatin County:		Blaine County:		Custer County:		Fergus County:		Glacier County:		Granite County:		Harrison County:		Jefferson County:		Liberty County:		Mussouri County:		Park County:		Ponderosa County:		Reno County:		Sheridan County:		Teton County:		Yellowstone County:		Gallatin County:		Blaine County:		Custer County:		Fergus County:		Glacier County:		Granite County:		Harrison County:		Jefferson 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County:		Liberty County:		Mussouri County:		Park County:		Ponderosa County:		Reno County:		Sheridan County:		Teton County:		Yellowstone County:		Gallatin County:		Blaine County:		Custer County:		Fergus County:		Glacier County:		Granite County:		Harrison County:		Jefferson County:		Liberty County:		Mussouri County:		Park County:		Ponderosa County:		Reno County:		Sheridan County:		Teton County:		Yellowstone County:		Gallatin County:		Blaine County:		Custer County:		Fergus County:		Glacier County:		Granite County:		Harrison County:		Jefferson County:		Liberty County:		Mussouri County:		Park County:		Ponderosa County:		Reno County:		Sheridan County:		Teton County:		Yellowstone County:		Gallatin County:		Blaine County:		Custer County:		Fergus County:		Glacier County:		Granite County:		Harrison County:		Jefferson County:		Liberty County:		Mussouri County:		Park County:		Ponderosa County:		Reno County:		Sheridan County:		Teton County:		Yellowstone County:		Gallatin County:		Blaine County:		Custer County:		Fergus County:		Glacier County:		Granite County:		Harrison County:		Jefferson County:		Liberty County:		Mussouri County:		Park County:		Ponderosa County	
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See footnote at end of table.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1944, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Sanders County:													
Camas Prairie.....	1		233	4		4	405		405	19,400			\$3,047
Eagle.....	1		9,831	17		17	10,350		10,350	22,200	2,266,100	183,500	212,369
Beavals Creek.....	1		25	7		7	45		45	17,400			2,626
Silver Bow County:													
Highland.....	1		1	11		11	488		488	1,800			385
Melrose.....	2		33	1		1	45,599		45,599	192,900		426,500	625
Smelter.....	1		26,084	1,010		1,010	5,955,608		5,955,608	5,000			132,504
Summit Valley.....	22	1	5,403,813	14,439	2	14,441	6,955,608		6,955,608	234,726,400	6,502,100	16,747,000	38,743,789
Total Montana.....	188	24	6,049,462	43,798	6,223	50,021	7,092,720	493	7,093,215	236,380,000	26,210,000	72,254,000	49,039,865

¹ Barker district lies in Cascade and Judith Basin Counties.

BEAVERHEAD COUNTY

Argenta district.—A total of 1,398 tons of ore was produced from mines in the Argenta district in 1944; 833 tons of lead ore and 31 tons of zinc-lead ore came from the Iron Mountain property, 524 tons of lead ore from the Louis Phillip mine, and 10 tons of gold ore from the El Fino mine. Most of the ore was shipped to smelters.

Bannack district.—In 1944 G. D. Hartman shipped 63 tons of gold ore from the Pioneer mine to the Anaconda copper smelter.

Bryant district.—L. D. Foreman continued to operate the Hecla mine and dumps in 1944 and shipped a total of 8,336 tons of siliceous gold ore, lead ore, zinc-lead ore, silver-lead tailings, and slag to smelters in Utah. The total output included 5,963 tons of old smelter slag containing an average of 6.4 percent lead and 7.8 percent zinc and minor quantities of gold, silver, and copper. The slag was smelted first in the Tooele lead blast furnace, and the resultant hot slag was treated in the slag-fuming furnace at Tooele for recovery of zinc-lead oxide fume.

Horse Prairie Creek or Colorado district.—A small lot of lead ore from the H & S mine was shipped in 1944 to the East Helena lead smelter, and placer gold was recovered by sluicing at the Gold Leaf property on Jeff Davis Creek.

Lipond district.—The Quartz Hill Leasing Co. operated Quartz Hill Mines in 1944 and shipped highly siliceous silver ore to the Anaconda copper smelter. Some of the ore contained enough silica for use as converter flux. Other production in the district was a small lot of silver ore from the Monte Cristo claim and a small lot of gold ore from the Star claim.

BROADWATER COUNTY

Beaver district.—The bulk of the output of the Beaver district in 1944 came from operations of the East Pacific and East Pacific Tunnel No. 4 claims. The property was worked continuously in 1944, and during the year a 30-ton gravity-concentration mill was built; 3,000 tons of silver-lead old tailings were treated, which yielded 289 tons of lead concentrates. In addition, 458 tons of crude silver-lead ore were shipped to a smelter and 105 tons of zinc-lead ore to the Midvale (Utah) custom concentrator. Other production in the district was 145 tons of gold ore shipped to a smelter from the Vosburg, Edna No. 2, Native Silver, and Joe Dandy mines and 88 tons of zinc-lead ore shipped from the January claim.

Cedar Plains district.—A total of 731 tons of lead ore and zinc-lead ore was produced from mines in the Cedar Plains district in 1944. It comprised 526 tons of zinc-lead ore from the North Star and Ruby Silver properties and 205 tons of lead ore from the Cleo, Dandy, and Santa Anita properties.

Park or Indian Creek district.—The Broadwater Zinc & Lead Co. operated its Iron Mask property throughout 1944 and shipped 4,885 tons of zinc ore to the East Helena lead smelter. Zinc was recovered by fuming the hot slag that resulted from smelting the ore first in the lead blast furnace at East Helena. In addition, the company treated approximately 1,000 tons of silver ore in its 50-ton concentration mill, which yielded 291 tons of zinc-lead concentrates. The remainder of the district production was gold ore and included 75 tons smelted from the Little Giant and Marietta properties and 412 tons amalgamated from the Diamond Hill and Silver Star properties.

CASCADE COUNTY

Barker district.—Andrew Fineide and Edward Thomson operated the Fairplay & Bon Ton group throughout 1944 and shipped 525 tons of zinc-lead ore to the custom concentrator at Midvale, Utah. The ore averaged about 5.3 ounces of silver to the ton, 25.7 percent zinc, 9 percent lead, and minor quantities of gold and copper.

Montana district.—The value of the metal output in the Montana district in 1944 was \$343,865 compared with \$278,396 in 1943; a substantial increase in production of zinc with smaller gains in production of lead and copper accounted for the increased value of the output. Virtually all the output was zinc-lead ore and silver ore treated in four flotation mills in the district. The Bennett Mining Co., assisted financially by the Reconstruction Finance Corporation, reopened the Dacotah group late in 1943 after the property had been idle over 30 years. In 1944 the company treated 12,286 tons of zinc-lead ore in the Florence 75-ton flotation mill, which yielded 339 tons of lead concentrates and 1,056 tons of zinc concentrates. The Neihart Mine & Milling Co. operated the Broadwater group and 80-ton flotation mill (formerly known as the Klies mill) throughout 1944. The company treated 19,002 tons of zinc-lead ore (containing 4.5 ounces of silver to the ton, 2.6 percent lead, and 2.4 percent zinc), which yielded 529 tons of lead concentrates and 446 tons of zinc concentrates. A total of about 11,400 tons of silver ore from the Star-Galt-London groups was treated in the 40-ton Star flotation mill by the New London Mining Co.; the resulting zinc-lead concentrates (198 tons) were shipped to the East Helena lead smelter. About 3,400 tons of gold-silver ore from the Benton group and 1,661 tons of silver ore from the Ripple mine were treated in the 100-ton Lexington flotation mill in 1944 by the Montana Leasing Co.; the resulting zinc-lead concentrates produced from the gold-silver ore and the silver-lead concentrates from the silver ore were shipped to a lead smelter. A little silver ore was produced also from the Minute Man mine.

FERGUS COUNTY

Cone Butte district.—A car of copper ore from the North group was shipped in 1944 to the Anaconda Copper Co. smelter by the Hamilton Copper Co.

FLATHEAD COUNTY

Hog Heaven district.—The output in the Hog Heaven district in 1944 was all siliceous silver ore shipped to a smelter. The Flathead and West Flathead mines, owned and operated by the Anaconda Copper Mining Co., produced 3,181 tons of ore, which was shipped to the Washoe Sampling Works at Anaconda; the remainder of the district production was 39 tons of silver ore shipped from the Flag-Martin mine.

GRANITE COUNTY

Boulder and South Boulder district.—Leon Heroux shipped a small lot of lead ore rich in silver from the Annie claim in 1944 to the East Helena smelter. The placer output was negligible.

Dunkleberg district.—All the output of the Dunkleberg district in 1944 came from the Forest Ross mine, operated under lease by the

Forest Rose Syndicate The company 80-ton flotation mill was operated throughout the year and treated 17,064 tons of zinc-lead ore, recovering 415 tons of lead concentrates and 690 tons of zinc concentrates. The ore treated contained an average of 2 percent lead and 3.4 percent zinc compared with an average content of 2.7 percent lead and 3.4 percent zinc in 1943. Considerable underground development was completed in 1944 in the Forest Rose mine.

First Chance district.—The Consolidated Mining Co., Inc., spent most of the year developing its Queen Helen mine of the Mitchell group; however, during the course of development 713 tons of silver ore were mined and shipped to the Washoe Sampling Works at Anaconda. The remainder of the district production was gold ore shipped to a smelter from the Homestake and Lynx properties and placer gold from the Lucky Jim and Ten Mile claims.

Flint Creek district.—In 1944, as in prior years, old tailings (silver) from the Granite-Bimetallic dumps were the chief source of metal production in the Flint Creek district. J. C. and Juanita Yob shipped 3,450 tons of these old tailings to the Tacoma (Wash.) smelter, to be used there as flux. Joseph T. Farrow operated the Two Per Cent property under lease until October 6, when all operations ceased. During the year 1,465 tons of zinc ore were shipped to the Anaconda zinc concentrator and 4 tons of crude silver ore to the Washoe Sampling Works. The Trout Mining Division of American Machine & Metals, Inc., produced chiefly manganese ore from its Trout mine in 1944; however, some sorted low-grade gold ore (1,942 tons) was shipped to smelters. Zinc ore (188 tons) was produced by the Moorlight Mining Co. from its Moorlight group, but the company's major output was high-grade manganese ore shipped mainly for use in the manufacture of batteries and lower-grade ore shipped to the Metals Reserve Company stock pile at Philipsburg. Zinc ore (84 tons) was produced also from the Silver Prince mine by the Contact Mines Corp., but its chief output was manganese ore. Other production in the district in 1944 was 44 tons of zinc ore from the Wenger No. 2 claim and 4 tons of copper ore from Comanche Extension claim.

Henderson district.—H. & H. Mines operated its floating connected-trucket dredge, equipped with $3\frac{1}{4}$ -cubic foot buckets, on Henderson Creek Gulch from March 21 to December 24 and recovered tungsten and abrasive sands in addition to gold and silver. During the period of operation, 50,000 cubic yards of overburden were moved and 620,000 cubic yards of gravel were washed, resulting in the recovery of 3,582 fine ounces of gold, 225 ounces of silver, 15,790 pounds of tungsten, and 88,000 pounds of abrasive sands. A special scheelite concentrator was operated in conjunction with the dredge.

JEFFERSON COUNTY

Boulder and Little Boulder district.—Silver ore (674 tons) from the Baltimore mine was shipped to the East Helena smelter.

Cataract district.—Many small operations were active in the Cataract district in 1944; the principal output was 1,063 tons of siliceous gold-silver tailings from the Blue Bird tailings dump shipped to the East Helena lead smelter for flux. O. O. Alexander and partners shipped 387 tons of zinc-lead ore to the Midvale (Utah) concentrator for treatment; J. K. Curtiss shipped 153 tons of gold-silver ore from

the Morning Glory mine to the Washoe Sampling Works at Anaconda; and Rufus Turner treated 70 tons of gold ore in his 25-ton amalgamation-concentration mill. The rest of the district output was mainly ore shipped crude to smelters from the Silver Hill, Klondyke, Bullion, Russell, Silver King, Comet, Crystal, Hope, and Boulder properties.

Colorado district.—The value of the metal output from the Colorado district decreased 4 percent compared with 1943; the output of gold and zinc increased, but that of silver, copper, and lead decreased. The Monongahela-Mount Washington Mining Co., by far the most important producer in the district, operated its Mount Washington mine throughout the year. The company 150-ton flotation mill ran during the first 2 months of 1944 and treated 6,318 tons of zinc-lead ore which yielded 136 tons of lead concentrates and 200 tons of zinc concentrates. Most of the zinc-lead ore mined was oxidized. In addition to the milling operation, the company made regular shipments of oxide zinc-lead ore to the East Helena smelter. The ore (6,607 tons) was smelted at the East Helena lead blast furnace, and the resulting slag was fumed for the recovery of zinc. Louis Peura and the American Smelting & Refining Co. worked the Minah waste dumps and shipped 3,720 tons of gold-silver ore to East Helena. The rest of the district output was principally silver ore and gold-silver ore from the Gregory mine and gold-silver ore from the Blizzard and Blue Bird properties.

Elkhorn district.—The Elkhorn dump continued in 1944 to be the chief source of metal production from the Elkhorn district; however, the output was about half that in 1943. A power shovel was used to load the old tailings, which were shipped to East Helena to be used there as flux; the material averaged 6.6 ounces of silver to the ton, 1.8 percent lead, and 4.5 percent zinc, with minor quantities of gold and copper. A little gold ore was shipped to the East Helena smelter from the Klondyke mine.

Mitchell district.—High-grade gold ore (21 tons) was produced from the Last Chance mine near East Helena.

Whitehall district.—The Golden Sunlight property was the third-largest gold producer in Montana in 1944. Marvin Reibhoff operated the property throughout the year and shipped 15,047 tons of highly siliceous gold ore to the Anaconda copper smelter at Anaconda. The ore is sufficiently high in silica for use as converter flux at the smelter. Lessees operated the Carbonate and Perhaps mines in 1944 and shipped 1,042 tons of lead ore to the East Helena lead smelter; both properties are owned by the Anaconda Copper Mining Co. The remainder of the district output was principally 424 tons of gold ore shipped from the Lucky Hit mine and 183 tons of lead ore from the Surprise and Minerva properties.

Wilson and Ticer Creeks district.—High-grade gold ore (81 tons) was produced from the Callahan group and shipped to a smelter.

JUDITH BASIN COUNTY

Barker district.—Thorson and Brazee purchased in 1944 part of the holdings (including the Edwards mine) of the St. Joseph Lead Co. in the Barker district. During the year the partnership shipped 44 tons of lead ore and clean-up material to the East Helena smelter.

Yogo district.—Walter Lehman operated the Gold Bug mine a short time in 1944 and shipped 55 tons of gold ore to a smelter.

LEWIS AND CLARK COUNTY

Hobbsville district.—The value of the metal production in the Hobbsville district was 16 percent greater than in 1943. The Mike Horse mine, one of the chief producers of zinc and lead in Montana, is operated continuously in 1944 by the Mike Horse Mining & Milling Co. The company treated 57,767 tons of zinc-lead-copper concentrates and 2,591 tons of zinc concentrates. The mine and mill were operated at a capacity consistent with the available manpower. The Swansea Mines, Inc., completed erecting a 75-ton flotation mill at the Carbonate mine in 1944 and began milling operations in August. During the rest of the year a total of 2,713 tons of lead ore was treated in the mill, making 197 tons of lead concentrates. In addition, 7 tons of crude lead ore were shipped to a smelter.

Helena district.—The output of the Helena district was small lots of ore shipped to smelters from the Copper Cliff, Victory, and Krug properties. The placer output has been negligible since the closing in August 1943 of Porter Bros. bucket dredge.

Marysville district.—Martin Bros. treated about 3,000 tons of lead ore in 1944 from the Earthquake and Shakopee mines in its 35-ton flotation mill; the Montana Rainbow Mining Co. operated its Drum-Common mine and shipped 2,191 tons of siliceous gold ore to the East Helena lead smelter; and a lessee worked the Belmont mine and shipped 59 tons of gold ore to various smelters. The rest of the district production was 5 tons of zinc-lead ore from the Enterprise mine.

Missouri River district.—The Perry-Schroeder Mining Co. operated a dredge, equipped with 6-cubic foot buckets, on the Missouri River from January 1 to April 12, when all operations ceased. A total of 77,600 cubic yards of gravel was washed in 1944, yielding gold, silver, and a small amount of platinum and osmium. In its 1944 report the company states that operations stopped owing to exhaustion of dredge ground at Eldorado Bar.

Bimini district.—The most important producer, by far, in the Bimini district in 1944 was the Armstrong Syndicate, which operated the Armstrong property under lease and shipped 3,647 tons of lead ore to East Helena and 58 tons of zinc-lead ore to the Midvale (Utah) concentrator. The rest of the district output was principally 205 tons of lead ore shipped from property operated by the South Dakota Mining Associates and 81 tons of gold ore produced from the Clementh mine.

Smelter district.—The most important zinc producer and one of the leading lead producers in Montana in 1944 was the Anaconda slag-fuming plant at East Helena, owned and operated by the Anaconda Copper Mining Co. The plant was in continuous operation, except for short periods resulting from the closing for repairs of the East Helena lead blast furnace. The bulk of the slag treated in 1944 was current hot slag from the East Helena lead smelter; this slag resulted from the smelting of ores, concentrates, and zinc-smelter (electrolytic) lead residues. A total of 233,948 tons of current hot slag and cold slag was fumed and produced zinc-lead fume; however, the slag plant is credited only with 187,988 tons of slag fumed and the zinc-lead fume produced therefrom. The difference in slag fumed and products derived is credited to those mines which shipped to the East Helena lead smelter ores or concentrates that contained at least 6 percent zinc.

The American Smelting & Refining Co. resmelted 12,018 tons of old silver-copper-lead slag in 1944, and the Anaconda Copper Mining Co. shipped several thousand tons of zinc-smelter (electrolytic) lead residues to the Tooele (Utah) lead smelter.

LINCOLN COUNTY

Libby district.—The Standard Silver Lead Mining Co. operated its 60-ton flotation mill from May 1 to November 18—20 days on Snowshoe mine ore and the remainder on old tailings. A total of 4,700 tons of zinc-lead ore and old tailings was treated, making 155 tons of zinc-lead concentrates and 125 tons of zinc concentrates. In addition, 309 tons of zinc-lead ore were shipped direct to the East Helena lead smelter. The remainder of the district output was 11 ounces of placer gold recovered from the Comet and Liberty claims.

Troy or Grouse Mountain district.—The Big Eight mine was operated under lease about 60 days in 1944 by the Chance Mining Co. The company shipped 30 tons of zinc-lead ore to the East Helena smelter and 267 tons of similar ore to custom concentration mills in Utah.

MADISON COUNTY

McCarthy Mountain district.—Herman Mueller operated the Polly Jane mine and shipped 198 tons of lead ore to various smelters.

Norris and Norwegian district.—The output from the Norris and Norwegian district in 1944 was 469 tons of gold ore shipped to smelters and came from the Boaz, Lincoln, Emperor, and East Revenue mines; the Boaz contributed 447 tons of the total. The mine was operated from January 1 to October 1 by the Boaz Mining Co.; thereafter it was turned over to lessees.

Pony and South Boulder district.—The only output in the Pony and South Boulder district in 1944 was 36 tons of clean-up material from the Mammoth mill and 13 tons of gold ore from the Raspberry mine.

Rochester district.—Hatfield and Jacobson operated the Calvin mines throughout 1944 under lease and shipped 1,355 tons of zinc-lead ore to the Tooele (Utah) lead smelter. Camilla Gage operated the Emma mine and shipped 129 tons of lead ore to the East Helena lead smelter and 100 tons of zinc-lead ore to the Midvale (Utah) concentrator. Other production from the district was 56 tons of lead ore from the Jack Rabbit and Ajax mines.

Sheridan district.—In 1944 the Toledo-Buckeye property near Sheridan was an important producer of silver, lead, and zinc. The Victoria Mines, Inc., operated the property throughout the year and treated 32,785 tons of zinc-lead ore in its 120-ton Victoria flotation mill near Silverstar, compared with 20,438 tons in 1943. The Bureau of Mines, through its exploratory drilling program, revealed in 1944 important reserves of zinc-lead ore in the Toledo-Buckeye group, which are now being exploited. The remainder of the district output was principally 3,240 tons of low-grade gold-copper ore shipped to a smelter from the Dictator mine.

Silver Star district.—About 100 tons of rich gold ore from the Stella mine were shipped to a smelter, and small lots of zinc ore and lead ore from the Mary Lou claim were shipped to the Midvale (Utah) plant.

Tidal Wave district.—The output of the Tidal Wave district in 1944 comprised several classes of ore shipped to smelters; most of it was

4 tons of copper ore from the Johnston and Moffet groups and 19 tons of lead ore from the Inspiration mine.

Virginia City district.—Walter H. Myers took over the U. S. Grant mine and began operations July 1. During the remainder of 1944 a total of 1,756 tons of gold-silver ore was shipped to the Washoe Sampling Works. Some gold-silver ore from the Lone Star waste dump and some mill cleanings (gold) from the old Marietta mill also were shipped.

Washington district.—A little gold ore was produced and shipped from the Snowslide mine.

MEAGHER COUNTY

Castle Mountain district.—Lessees worked at the Cumberland waste dump and shipped 108 tons of lead-silver ore to the smelter at East Helena.

MINERAL COUNTY

Keystone district.—E. G. Smith reopened the Nancy Lee mine under lease agreement and made a test mill run of 1,303 tons of zinc-lead ore from the Silver Crescent mill near Wallace, Idaho.

Packer Creek district.—The Hecla Mining Co. operated the Silver Cable mine under lease from April 1 to November 18, 1944; the property is inaccessible during the winter months owing to heavy snowfall. During the year the company hauled 11,286 tons of zinc-lead ore from the mine to its flotation mill at Burke, Idaho. The ore yielded 55 tons of lead concentrates and 2,696 tons of zinc-lead concentrates.

MISSOULA COUNTY

Coloma district.—The only output in the Coloma district in 1944 was 7 tons of gold ore shipped from the Mammoth group and 3 tons of copper ore produced from the Josephine mine.

Wallace district.—A lessee operated the Hidden Treasure mine and shipped 212 tons of silver ore to the Washoe Sampling Works.

PARK COUNTY

New World district.—The McLaren Gold Mines Co. operated the Estelle-New Year's Gift group of properties throughout 1944 and treated 21,352 tons of gold ore in its 100-ton flotation mill, which yielded 779 tons of copper concentrates containing 3,857 ounces of gold, 4,985 ounces of silver, and 205,988 pounds of copper. The Emma mine produced a total of 626 tons of zinc-lead ore, of which 126 tons were shipped to East Helena, and the rest was shipped to the Anaconda zinc concentrator for treatment.

Sheepwater district.—The Jardine Mining Co. operated its Jardine mine continuously in 1944 and its 400-ton combination flotation-cyanide-amalgamation mill 11 months. The mill began operating February 1, and during the year a total of 50,430 tons of gold-arsenic ore was treated and yielded 5,879 ounces of gold and 1,526 ounces of silver in bullion and 693 tons of gold concentrates containing 1,264 ounces of gold, 416 ounces of silver, and a little copper; in addition to these metals, the operation yielded arsenic trioxide.

POWELL COUNTY

Nigger Hill district.—Hopkins & Sons Mining Co. produced the bulk of the output in the Nigger Hill district in 1944. The company mined a total of 1,493 tons of ore from the Charter Oak mine, of which 1,481 tons were zinc-lead ore treated in the company 50-ton flotation mill and 9 tons silver ore shipped to a smelter. The milling ore yielded 7 tons of lead concentrates and 39 tons of zinc concentrates. The remainder of the district output was nearly all zinc-lead-silver ore produced from the Lilly group.

Pioneer district.—The output of the Pioneer district comprised 1 ton of lead-silver ore from the Lois claim and 56 ounces of placer gold cleaned up from former dredging operations.

RAVALLI COUNTY

Curlew district.—The Hamilton Victor Mining & Milling Co. operated the Curlew mine near Victor throughout 1944 and its 70-ton flotation mill the first 9 months; the mine was developed during the last quarter of the year with favorable results. The mill treated 4,170 tons of gold-silver-copper-lead-zinc ore, recovering 91 tons of lead-copper concentrates and 95 tons of zinc concentrates.

SANDERS COUNTY

Camas Prairie district.—In 1944 a lessee continued to operate the Glaucus mine and shipped 233 tons of copper ore to a smelter.

Eagle district.—All the ore mined in 1944 from the Jack Waite property, which extends over the State line into Idaho, came from that portion within Montana. The property was operated throughout the year by the American Smelting & Refining Co. and produced 9,770 tons of zinc-lead ore containing 10,649 ounces of silver, 2,209,974 pounds of lead, and 304,824 pounds of zinc. The ore was milled in the company-owned 300-ton flotation mill at Duthie, Idaho; 1,334 tons of lead concentrates and 214 tons of zinc concentrates were produced. Sorted lead ore shipped to a smelter amounted to 161 tons and contained 915 ounces of silver and 260,313 pounds of lead.

Revais Creek district.—The Green Mountain Mining Co. operated the Drake property near Dixon and shipped 25 tons of high-grade copper ore to a smelter.

SILVER BOW COUNTY

The value of the metal output of Silver Bow County was \$38,877,303 in 1944 compared with \$42,100,656 in 1943—an 8-percent loss. The output of gold, silver, and copper decreased, whereas that of lead and zinc increased. The gain in production of lead and zinc resulted principally from an increase in output of zinc-lead ore from the Poulin mine at Butte. Although the Anaconda Copper Mining Co. (only active major producer in the county in 1944) treated a greater quantity of copper material than in 1943, the total content in gold, silver, and copper was less. The increased tonnage and decreased metal content resulted from the treatment of a greater portion of mine dumps and waste tailings. The only zinc ore produced on company account, aside from the zinc-lead-middling product made from the

treatment of manganese ore, was extracted in the course of development or exploration in the company zinc mines. The following table gives the output of mines in Silver Bow County (which includes the Butte or Summit Valley district) in 1943 and 1944 and the total from 1882 to the end of 1944.

Production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., 1943-44, and total, 1882-1944, in terms of recovered metals

Year	Mines producing	Ore (short tons)	Gold (lode and placer) (fine ounces)	Silver (lode and placer) (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
1943	28	5,163,906	16,132	6,487,380	267,187,700	6,572,400	15,754,000	\$42,100,656
1944	27	5,429,931	15,463	6,001,695	234,732,200	6,695,000	16,173,500	38,877,303
1882-1944		(¹)	2,008,787	538,390,100	² 6,397,964	² 229,580	² 1,555,168	2,546,027,562

¹ Figures not available.

² Short tons.

Butte or Summit Valley district.—The following operational details are taken in part from the Anaconda Copper Mining Co. printed annual report for the year ended December 31, 1944.

The company operations in Montana in production, reduction, and processing of metals were curtailed by a critical shortage of manpower in practically all departments. No important construction program was undertaken at any of the company plants in Montana during 1944. The aggregate tonnage of copper mine ore, dumps, waste tailings, and slimes treated exceeded that in 1943 by 4 percent. The copper concentrator at Anaconda treated 2,362,041 tons of copper ore from company-owned Butte mines compared with 3,197,206 tons in 1943; and 3,706 tons of copper mine-water precipitates were treated compared with 3,582 tons in 1943. In addition, the copper concentrator at Anaconda treated 1,387,782 tons of New Works sand tailings compared with 812,513 tons in 1943 (in both years the tailings averaged about 0.6 percent copper); 752,571 tons of mine dumps averaging about 0.8 percent copper) compared with 404,359 tons in 1943; 125,372 tons of special waste compared with 88,314 tons in 1943; and 4,364 tons of Old Works tailings compared with 372,049 tons in 1943. Crude ore from the Butte mines amounted to 67,642 tons and special waste 1,936 tons.

The slime-disintegrating plant, with a daily rated capacity of 2,000 tons, treated slimes in 1944 as follows: 279,007 tons of Butte and Boston slimes, 207,133 tons of New Works Valley Pond slimes, and 28,340 tons of Old Works slimes; the 514,480 tons of slimes treated averaged 1.36 percent copper. In 1943 the plant treated 13,816 tons of slimes from all sources. The zinc concentrator was utilized for a dual purpose in 1944. The crushing and grinding equipment was used for treatment of copper mine dumps from Butte. After being ground to flotation size, one-fourth of the total dumps material was floated in a 14-cell flotation machine at the zinc concentrator; the rest was sent to the copper concentrator for treatment. The remainder of the feed to the zinc concentrator was a sulfide middling concentrate from manganese ore.

The Anaconda Copper Mining Co. operated the property of the North Butte Mining Co. throughout 1944 under contract agreement. The output from the property was 130,113 tons of copper mill ore and 126 tons of copper mine-water precipitates compared with 100,368 and 176 tons, respectively, in 1943. A total of 1,181 tons of zinc ore was mined from all company zinc mines incident to exploration and development. Development at all company copper mines consisted of 687 feet of shaft, 191,712 feet of drifts, and 5,182 feet of diamond-drill holes; at all company zinc mines, 1,706 feet of drifts and 199 feet of diamond-drill holes. The Emma mine was operated throughout 1944 by the Anaconda Copper Mining Co. under lease agreement. Production totaled 21,644 tons of zinc-lead middlings (from the treatment of manganese ore). In addition, 3,487 tons of zinc-lead middlings were produced as a byproduct from the milling of manganese ore from the Travona mine; all middlings were treated in the Anaconda zinc concentrator. Development comprised 13,872 feet of drifts in the Emma mine and 4,862 feet of drifts and 143 feet of diamond-drill holes in the company-owned manganese mines.

Lessees of the Anaconda Copper Mining Co. operated several properties at Butte in 1944 and produced about 16,700 tons of ore; the most productive was the Poulin mine, which yielded 15,284 tons of zinc-lead ore containing about 500 ounces of gold, 80,000 ounces of silver, 167,000 pounds of copper, 1,130,000 pounds of lead, and 4,500,000 pounds of zinc. The remainder of the district output was mainly 13,786 tons of material (containing chiefly silver and lead) shipped direct to the East Helena lead smelter from the Alloy dump.

Smelter district.—The Domestic Manganese & Development Co. treated manganese ore from mines principally in the Butte and Flint Creek (Philipsburg) districts in 1944. This ore was from current mine production as well as from the Metals Reserve Company stock pile at Philipsburg and comprised both oxide and sulfide minerals. A zinc-lead-middling product (26,084 tons) was made as a byproduct; this was separated into a zinc-lead concentrate (850 tons) and a zinc concentrate (319 tons).

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA

(MINE REPORT)

By CHARLES WHITE MERRILL

SUMMARY OUTLINE

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SUMMARY

The quantity and value of zinc produced in Nevada in 1944 were the highest in the history of the State. Lead output was the highest in quantity and value since 1941. The total value of gold, silver, copper, lead, and zinc recovered from ore, old tailings, and gravels in Nevada, however, decreased 3 percent compared with 1943 because of smaller outputs of copper, gold, and silver. Higher wages, enlistment of miners in the armed forces, migration of miners to war industries and military construction jobs, rising prices of supplies and equipment and difficulties in obtaining them, increased taxes, and fixed prices for gold and silver were factors in reducing the total output, despite Nevada's great mineral resources and the war demand on many of them. The continued enforcement of War Production Board Order L-208 of October 8, 1942, was also a factor in the lowered output of gold mines. Grants to operate under the order were given eight companies during 1944, and seven grants issued in 1943 continued in force.

Comparing 1944 with 1943, gold output decreased 18 percent and silver 22 percent in both quantity and value; copper decreased 14 percent in quantity and 11 percent in value; lead increased 38 percent in quantity and 47 percent in value; and zinc increased 52 percent in quantity and 60 percent in value. Of the total value of the five metals, copper comprised 61 percent, zinc 17, gold 15, lead 4, and silver 3 percent.

White Pine County continued its lead over the other counties and produced 62 percent of the State total value of the five metals; it stood first in output of copper and of gold and second in silver and zinc. Lincoln County produced 20 percent of the State total value and ranked second to White Pine County; it led in the State in zinc, lead, and silver.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ³	Zinc ³
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940.....	\$35.00	\$0.711+	\$0.113	\$0.050	\$0.06
1941.....	35.00	0.711+	.118	.057	.07
1942.....	35.00	0.711+	.121	.067	.09
1943.....	35.00	0.711+	.130	.075	.10
1944.....	35.00	0.711+	.135	.080	.114

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price includes bonus payments by Metals Reserve Company for overquota production.

⁴ \$0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Nevada, 1940-44, and total, 1859-1944, in terms of recovered metals

Year	Mines producing ¹		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1940.....	895	115	8,338,259	383,933	\$13,437,655	5,175,928	\$3,680,660
1941.....	799	78	8,799,635	366,403	12,824,105	5,830,238	4,146,947
1942.....	434	49	9,383,879	295,112	10,328,920	3,723,436	2,647,776
1943.....	168	17	8,364,043	144,442	5,055,470	1,620,280	1,152,199
1944.....	146	11	6,863,505	119,056	4,166,960	1,259,636	895,741
1859-1944 ²			(³)	26,334,056	565,253,636	587,309,681	538,974,117

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1940.....	156,908,000	\$17,730,604	14,998,000	\$749,900	23,666,000	\$1,490,958	\$37,089,777
1941.....	157,822,000	18,622,996	19,246,000	1,097,022	30,258,000	2,269,350	38,959,420
1942.....	167,326,000	20,246,446	10,752,000	720,384	20,394,000	1,896,642	35,840,168
1943.....	142,136,000	18,477,680	9,580,000	718,500	27,294,000	2,947,752	28,351,601
1944.....	122,464,000	16,532,640	13,210,000	1,056,800	41,398,000	4,719,372	27,371,513
1859-1944 ²	1,681,457	475,751,288	533,730	57,604,067	303,382	45,027,050	1,682,610,168

¹ Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

² Compiled by Chas. W. Henderson, Metal Economics Division, Bureau of Mines. From 1904 (when first satisfactory annual canvass of mine production was made) to 1944, inclusive, the output was as follows: Gold, 13,507,179.51 ounces valued at \$320,770,403; silver, 298,896,832 ounces, \$201,815,894; copper, 1,679,531 tons, \$475,104,660; lead, 295,939 tons, \$34,967,605; zinc, 303,382 tons, \$45,027,050; total value, \$1,077,665,512.

³ Figures not available.

⁴ Short tons.

Gold.—Gold production in Nevada in 1944 was the lowest in quantity and value since 1933. Although the recession in gold began after the large output of 1940, monthly production did not assume a marked downward trend until August 1942. By February 1943 a much lower level had been established, which has persisted with minor fluctuations through 1944. This period of sharp decline included the weeks when War Production Board Limitation Order L-208, promulgated October 8, 1942, was taking effect.

The 10 leading gold-producing mines in 1944 supplied 94 percent of Nevada's output, and the 3 leaders contributed 70 percent. The curtailment of gold mining and the stimulation of base-metal mining is evidenced by the fact that byproduct gold from base-metal mines

1943 and 1944 exceeded gold derived from gold mines for the first time in the history of the State.

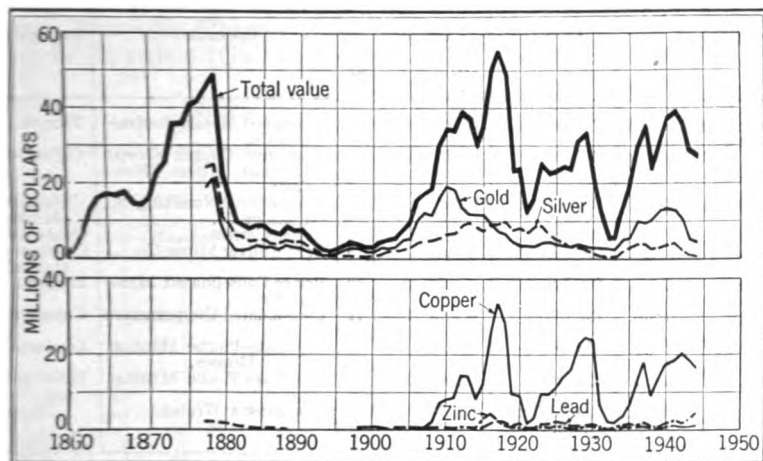


FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Nevada, 1860-1944.

Ten leading gold-producing mines in Nevada in 1944, in order of output

Mine	District	County	Rank in 1943	Operator	Source of gold
Gatchell	Potosi	Humboldt	2	Gatchell Mine, Inc.	Gold ore.
Ruth and Copper Flat Pit	Robinson	White Pine	1	Kenecott Copper Corp. (Nevada Mines Division)	Copper ore.
Copper Mines group	do	do	3	Consolidated Copper Mines Corp.	Do.
Goldacres	Bullion	Lander	6	Willow Creek Mines, Inc.	Gold ore.
Manhattan dredge	Manhattan	Nye	4	Manhattan Gold Dredging Co.	Dredge.
Copper Canyon	Battle Mountain	Lander	5	International Smelting & Refining Co.	Copper ore and old tailings.
Pioche Nos. 1 and 2 group	Pioche	Lincoln	11	Combined Metals Reduction Co.	Zinc ore.
Overman	Comstock	Storey	8	Consolidated Chollar Gould & Savage Mining Co.	Gold ore.
Consolidated Virginia	do	do	18	Consolidated Virginia Mining Co.	Gold-silver ore.
Mirpah	Tonopah	Nye	10	Various lessees	Do.

Silver.—The 10 leading silver-producing mines in Nevada in 1944 produced 70 percent of the State total recoverable silver; the first yielded 33 percent of the total. As in preceding years, most of the silver was a byproduct of ore mined chiefly for other metals; only 6 percent of it was derived from straight silver ore. Base-metal ores were the source of 81 percent of the State silver in 1944.

Ten leading silver-producing mines in Nevada in 1944, in order of output

Rank	Mine	District	County	Rank in 1943	Operator	Source of silver
1	Pioche Nos. 1 and 2 group.	Pioche.....	Lincoln.....	1	Combined Metals Reduction Co.	Zinc ore.
2	Ruth and Copper Flat Pit.	Robinson.....	White Pine..	3	Kennecott Copper Corp. (Nevada Mines Division).	Copper ore.
3	Copper Canyon.....	BattleMoun- tain.	Lander.....	7	International Smelting & Refining Co.	Copper ore and old tailings.
4	Mizpah.....	Tonopah.....	Nye.....	4	Various lessees	Gold-silver ore.
5	Bristol Silver.....	Jack Rabbit.	Lincoln.....	5	Bristol Silver Mines Co....	Copper and zinc-lead ore.
6	Prince.....	Pioche.....	do.....	10	Prince Consolidated Mining Co.	Zinc ore.
7	Coppermines group..	Robinson.....	White Pine..	11	Consolidated Coppermines Corp.	Copper ore.
8	Financier.....	Pioche.....	Lincoln.....	8	Salt Lake-Pioche Mining Co. and lessees.	Lead ore.
9	Apex.....	do.....	do.....	13	Salt Lake-Pioche Mining Co.	Silver and lead ore.
10	Trinity.....	BattleMoun- tain.	Lander.....	15	Symanzik & Wrobel.....	Do.

Copper.—Over 96 percent of the recoverable copper output of Nevada in 1944 came from mines operated by the following companies: The Kennecott Copper Corp. (Nevada Mines Division), working the Ruth mine at Ruth and the open pit at Copper Flat (both in the Robinson district, White Pine County); the Consolidated Coppermines Corp., working the Coppermines group at Kimberly (also in the Robinson district); and the Mountain City Copper Co., working the Mountain City mine at Mountain City (in the Cope district, Elko County). During 1944 the Kennecott Copper Corp. and the Consolidated Coppermines Corp. reached an agreement to extend the former company's open pit so as to mine ore belonging to the latter; preparatory stripping of overburden was under way at the end of 1944.

Lead.—Over 61 percent of the lead produced in Nevada in 1944 was mined in the Pioche district, Lincoln County, where the leading lead properties were: The Pioche Nos. 1 and 2 group operated by the Combined Metals Reduction Co., the Ely Valley mine operated by Ely Valley Mine, the Prince mine operated by the Prince Consolidated Mining Co., and the Financier mine operated by the Salt Lake-Pioche Mining Co. and lessees. Other important producers in the State were: The Bristol Silver Mines Co. Bristol Silver mine (Jack Rabbit district, Lincoln County), the Coronado Copper & Zinc Co. Yellow Pine mine (Yellow Pine district, Clark County), the Nevada Lead & Zinc Co. (Spruce Mountain district, Elko County), the International Mining Corp. Groom mine (Groom district, Lincoln County), and Hall Bros. Co., Inc., Tybo mine (Tybo district, Nye County).

Zinc.—In 1944, as in recent years, zinc production in Nevada was centered in the Pioche district, Lincoln County, where 87 percent of the State total for the year was mined. The Combined Metals Reduction Co., Prince Consolidated Mining Co., and Ely Valley Mine were the principal producers. Other important producers in the State outside the Pioche district were: Sam Robison Columbia mine (Robinson district, White Pine County), Coronado Copper & Zinc

Yellow Pine mine (Yellow Pine district, Clark County), Grand Deposit Mining Co. Grand Deposit mine (Aurum district, White Pine County), Bristol Silver Mines Co. Bristol Silver mine (Jack Rabbit district, Lincoln County), and Union Lead Mining & Smelting Co. Union Lode mine (Galena district, Washoe County).

MINE PRODUCTION BY COUNTIES

The production of gold, silver, copper, lead, and zinc in Nevada in 1944, by counties, in terms of recovered metals

County	Mines producing ¹		Gold						Silver (lode and placer)	
	Lode	Placer	Lode		Placer		Total		Fine ounces	Value
			Fine ounces	Value	Fine ounces	Value	Fine ounces	Value		
Churchill	3		51	\$1,785			51	\$1,785	6,075	\$4,320
Esmeralda	18		101	3,535			101	3,535	29,295	20,832
Lincoln	19	(?)	400	14,000	2	\$70	402	14,070	100,558	71,508
White Pine	7		1,478	51,730			1,478	51,730	3,853	2,740
Yuma	6		379	13,265			379	13,265	12,946	9,206
Yuma Mt.	7	1	35,654	1,247,890	5	175	35,659	1,248,065	5,071	3,606
Yuma	11	(?)	16,042	561,470	2	70	16,044	561,540	139,742	99,372
Yuma	12		3,330	116,550			3,330	116,550	512,401	364,374
Yuma	5		49	1,715			49	1,715	1,876	1,334
Yuma	6		64	2,240			64	2,240	5,331	3,791
Yuma	16	4	1,679	58,765	7,294	255,290	8,973	314,055	139,092	98,910
Yuma	10	5	574	20,090	48	1,680	622	21,770	27,003	19,202
Yuma	5		3,655	127,925			3,655	127,925	44,065	31,335
Yuma	3		94	3,290			94	3,290	8,623	6,132
Yuma Pine	18	1	48,153	1,685,355	2	70	48,155	1,685,425	223,705	159,079
Total, 1943	146	11	111,703	3,909,805	7,353	257,355	119,056	4,166,960	1,250,636	895,741
	168	17	133,213	4,662,455	11,229	393,015	144,442	5,055,470	1,620,280	1,152,199

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Churchill			194,000	\$15,520			\$21,625
Esmeralda	68,000	\$9,180	796,000	63,680	1,364,000	\$155,496	252,723
Lincoln	9,064,000	1,226,340	1,270,000	101,600	642,000	73,188	1,486,706
White Pine	80,000	10,800	206,000	16,480	400,000	45,600	54,630
Yuma	66,000	8,910	2,000	160			95,351
Yuma Mt.	1,652,000	223,020	218,000	17,440	4,000	456	1,260,741
Yuma	326,000	44,010	9,176,000	734,080	36,576,000	4,160,664	901,828
Yuma	634,000	85,590					5,428,678
Yuma	68,000	9,180	6,000	480			88,639
Yuma	4,000	540	564,000	45,120	128,000	14,592	15,691
Yuma	1,060,000	143,100	54,000	4,320			473,217
Yuma							189,392
Yuma							159,200
Yuma	16,000	2,160	132,000	10,560	512,000	58,368	80,510
Yuma Pine	109,406,000	14,769,810	590,000	47,200	1,772,000	202,008	16,863,522
Total, 1943	122,464,000	16,532,640	13,210,000	1,056,800	41,398,000	4,719,372	27,371,513
	142,136,000	18,477,680	9,580,000	718,500	27,294,000	2,947,752	28,351,601

¹Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

²Output from property not classed as a "mine."

MINING INDUSTRY

The 18-percent decline in total tonnage of ore and old tailings sold or treated in Nevada in 1944 compared with 1943 reflects a decline in copper ore output slightly greater than the decline in all ores taken together. The smaller copper-ore production resulted from a

chronic labor shortage throughout the State which grew progressively more acute as the year passed.

The connected-bucket dredge of the Manhattan Gold Dredging Co. in the Manhattan district, Nye County, was again the largest producer of placer gold and was fifth-largest of total gold in the State.

Except for this operation, Nevada placer mines were virtually quiescent.

ORE CLASSIFICATION

The following table classifying ores produced in Nevada in 1944 shows that 90 percent of the tonnage (including old tailings) sold or treated was copper ore and old tailings, 5 percent gold ore and old tailings, 3 percent zinc ore, and the remainder gold-silver ore, zinc-lead ore and old tailings, lead ore, and silver ore.

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore and old tailings sold or treated in Nevada in 1944, with content in terms of recovered metals

Source	Material sold or treated		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	<i>Short tons</i>	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Dry and siliceous gold ore.....	371, 831	2, 240	50, 103	29, 066	130, 600	84, 600	-----
Dry and siliceous gold-silver ore..	48, 087	-----	2, 985	135, 850	2, 400	34, 400	14, 700
Dry and siliceous silver ore.....	3, 551	-----	218	76, 428	4, 800	168, 600	4, 100
	423, 419	2, 240	53, 306	241, 344	137, 800	287, 600	18, 800
Copper ore.....	6, 180, 657	1, 310	54, 593	348, 267	122, 014, 500	29, 000	-----
Lead ore.....	13, 993	-----	503	163, 428	28, 900	2, 655, 200	6, 900
Zinc ore.....	225, 019	-----	3, 111	377, 945	52, 800	8, 155, 300	38, 973, 200
Zinc-lead ore.....	15, 540	1, 327	190	125, 748	230, 000	2, 082, 900	2, 399, 100
Total, lode mines.....	6, 858, 628	4, 877	111, 703	1, 256, 732	122, 464, 000	13, 210, 000	41, 398, 000
Total, placers.....	-----	-----	7, 553	2, 904	-----	-----	-----
	6, 858, 628	4, 877	119, 056	1, 259, 636	122, 464, 000	13, 210, 000	41, 398, 000
Total, 1943.....	8, 337, 311	26, 732	144, 442	1, 620, 280	142, 136, 000	9, 580, 000	27, 294, 000

¹ Includes 9,245,700 pounds of copper from precipitates.

² Includes 8,865,300 pounds of copper from precipitates.

METALLURGIC INDUSTRY

Of the 6,863,505 tons of lode material from Nevada mines sold or treated during 1944, 91 percent went to concentrating mills, 6 percent to amalgamation and cyanidation mills, and 3 percent to smelters; of the total, 0.07 percent was old tailings—all cyanided or smelted. Flotation was employed to the exclusion of gravity methods at concentration mills. Of the gold recovered as bullion, cyanidation supplied 98 percent and amalgamation 2 percent; of the silver recovered as bullion, 94 percent was derived by cyanidation and 6 percent by amalgamation. The tonnage of crude ore and old tailings shipped to smelters increased 20 percent compared with 1943.

The 500-ton selective-flotation mill operated by the Combined Metals Reduction Co. at Pioche, Lincoln County, treated zinc-lead and zinc ores upon a custom basis for several neighboring mines and also milled company zinc-lead ore. The mill's capacity was increased

1,000 tons daily during the year. The Kennecott Copper Corp. mined all the copper ore produced by the Consolidated Coppermines Corp. upon a contract basis, in addition to milling its own ore. The Kennecott Copper Corp. also operated the McGill copper smelter, Nevada's only smelter and the most important privately financed metallurgical plant in the State.

the production of metals in Nevada in 1944, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Amalgamated.....	1,063	1,131	2,835	-----	-----	-----
Raw ore and tailings cyanided.....	410,265	47,187	44,152	-----	-----	-----
Concentrates smelted:						
Flotation.....	268,095	57,416	704,667	103,211,400	8,191,200	37,042,800
Gravity.....	127	548	1,864	-----	-----	-----
Raw ore and tailings smelted.....	174,088	5,421	503,214	10,006,900	5,018,800	4,355,200
Concentrates smelted.....	-----	-----	9,245,700	-----	-----	-----
Total, lode mines.....	-----	111,708	1,256,732	122,464,000	13,210,000	41,398,000
Placer miners.....	-----	7,363	2,904	-----	-----	-----
Total, 1943.....	-----	119,066	1,259,636	122,464,000	13,210,000	41,398,000
Total, 1944.....	-----	144,442	1,620,280	142,136,000	9,580,000	27,294,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Nevada in 1944, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal					
	Ore ¹	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	<i>Short tons</i>	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Carlin.....	72	-----	9	4	-----	-----	-----	-----	-----	-----
Esmeralda.....	312	-----	197	110	-----	-----	-----	-----	-----	-----
Washoe.....	212	-----	117	24	-----	-----	-----	-----	-----	-----
Winnemuccia.....	18	-----	11	2	-----	-----	-----	-----	-----	-----
Yuma.....	303	-----	362	238	-----	-----	-----	-----	-----	-----
Verde.....	120	-----	310	255	9	124	500	-----	-----	-----
Elko.....	4	-----	70	2,178	-----	-----	-----	-----	-----	-----
Thermal.....	12	-----	65	24	-----	-----	-----	-----	-----	-----
Total, 1943.....	1,063	-----	1,131	2,835	9	124	500	-----	-----	-----
Total, 1944.....	1,471	50	2,263	1,631	-----	-----	-----	-----	-----	-----

CYANIDATION MILLS

Esmeralda.....	278,867	260	34,788	2,792	319	669	2,160	51,000	2,000	-----
Washoe.....	74,985	-----	9,356	1,056	-----	-----	-----	-----	-----	-----
Storey.....	56,153	-----	3,043	40,304	137	542	1,583	-----	-----	-----
Total, 1943.....	410,005	260	47,187	44,152	456	1,211	3,683	51,000	2,000	-----
Grand total:	396,550	22,572	48,033	332,554	480	668	6,142	64,000	5,700	-----
1944.....	411,058	260	48,318	46,987	465	1,335	4,183	51,000	2,000	-----
1943.....	396,021	22,622	50,286	334,185	480	668	6,142	64,000	5,700	-----

¹ Figures under "Ore" include both raw ore and concentrates amalgamated or cyanided, but not raw ore concentrated before amalgamation or cyanidation of concentrates.

Mine production of metals from concentrating mills in Nevada in 1944, in terms of recovered metals

BY COUNTIES

	Ore treated	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	Short tons	Fine ounces	Fine ounces	Pounds	Pounds	Pounds
Elko.....	73,055	20,500	219	41,180	6,681,700	174,100	219,400
Eureka.....	2,970	552	49	5,931		80,900	239,700
Lander.....	76,544	9,670	6,065	91,145	1,097,200		
Lincoln.....	210,815	41,204	3,013	352,144	11,600	7,678,400	35,972,400
Nye.....	1,063	195	87	11,852		120,500	93,500
Pershing.....	(1)	10	1	914		900	
Washoe.....	4,464	779	28	8,415	16,000	130,300	511,200
White Pine.....	5,909,188	194,847	47,167	190,767	95,353,900	4,100	6,600
Total, 1943.....	6,278,099	267,757	56,629	702,348	103,160,400	8,189,200	37,042,800
	7,798,687	283,745	74,392	709,189	124,205,800	5,838,700	25,300,100

BY CLASSES OF CONCENTRATES

Dry gold-silver.....	127	10	1,388	3,000	11,000	
Dry silver.....	10	1	914		900	
Copper.....	224,585	53,451	294,788	103,130,100	6,508,600	539,700
Lead.....	7,682	1,838	232,226	800	110,100	
Lead-copper.....	106	13	5,791	8,100	1,007,700	36,106,800
Zinc.....	34,410	1,095	144,855	10,900	550,900	396,300
Zinc-lead.....	837	221	22,386	7,500		
	267,757	56,629	702,348	103,160,400	8,189,200	37,042,800

¹ Tungsten ore.

Gross metal content of concentrates produced from ores mined in Nevada in 1944, by classes of concentrates

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	Fine ounces	Fine ounces	Pounds	Pounds	Pounds
Dry gold.....	146	666	2,083			
Dry gold-silver.....	127	10	1,388	4,414	12,075	63,977
Dry silver.....	10	1	914	67	1,442	
Copper.....	224,904	54,120	296,888	105,487,379	3,466	
Lead.....	7,682	1,838	232,226	2,374	6,637,936	823,678
Lead-copper.....	106	13	5,791	12,157	115,033	59,278
Zinc.....	34,410	1,095	144,855	12,335	1,109,486	40,120,157
Zinc-lead.....	837	221	22,386	11,471	561,608	606,864
Total, 1943.....	268,222	57,064	706,531	105,530,197	8,441,046	41,673,954
	284,225	75,060	715,331	125,075,951	6,016,047	28,613,146

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA 397

*the production of metals from Nevada concentrates shipped to smelters in 1944,
in terms of recovered metals*

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Clark	20,500	219	41,180	6,681,700	174,100	219,400
Esmeralda	552	49	5,931		80,900	239,700
Goldfield	319	669	2,100	51,000	2,000	
Lincoln	9,670	6,065	91,145	1,067,200		
Maricopa	41,204	3,013	352,144	11,600	7,678,400	35,972,400
Mojave	195	87	11,852		120,500	93,500
Nye	19	125	1,414		900	
Pahrump	137	542	1,583			
Springdale	779	28	8,415	16,000	130,300	511,200
Winnemuccia	194,847	47,167	190,767	95,353,900	4,100	6,600
Total, 1943	268,222	57,964	706,531	103,211,400	8,191,200	37,042,800
Total, 1944	284,225	75,060	715,331	124,269,800	5,844,400	25,300,100

BY CLASSES OF CONCENTRATES

Gold	146	666	2,083			
Gold-silver	137	10	1,388	3,000	11,000	
Silver	10	1	914		900	
Copper	224,904	54,120	296,888	103,181,100	2,000	
Lead	7,682	1,838	232,226	800	6,508,600	539,700
Aluminum	106	13	5,791	8,100	110,100	
Iron	24,410	1,065	144,855	10,900	1,007,700	36,106,800
Lead	837	221	22,386	7,500	550,900	396,300
Total, 1943	268,222	57,964	706,531	103,211,400	8,191,200	37,042,800

*the metal content of Nevada crude ore and old tailings shipped to smelters in 1944,
by classes of material*

Class of material	Material shipped		Gross metal content				
	Ore	Old tailings	Gold	Silver	Copper	Lead	Zinc
	<i>Short tons</i>	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Gold and siliceous gold	1,930	1,980	2,162	9,133	94,003	86,802	
Gold and siliceous gold-silver	5,587		1,221	101,278	2,238	31,154	
Gold and siliceous silver	3,520		218	76,330	4,495	267,997	5,677
Copper	125,006	1,310	1,142	53,479	19,254,026	41,403	
Lead	13,993		503	163,428	44,594	2,757,296	10,759
Aluminum	7,739		72	13,207	54,353	284,234	2,958,984
Iron	11,687	1,327	103	86,359	267,854	1,834,926	2,994,658
Total, 1943	169,471	4,617	5,421	503,214	19,721,563	5,303,812	5,970,078
Total, 1944	140,603	4,110	7,867	566,330	18,157,717	3,976,596	2,880,362

*Includes 9,367,856 pounds of copper contained in precipitates
*Includes 8,583,927 pounds of copper contained in precipitates.

Mine production of metals from Nevada crude ore and old tailings shipped to smelters in 1944, in terms of recovered metals

BY COUNTIES

	Material shipped		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	Short tons	Short tons	Fine ounces	Fine ounces	Pounds	Pounds	Pounds
Churchill.....	1,665		42	6,071		194,000	
Clark.....	3,714	1,327	101	20,295	68,000	798,000	1,364,000
Elko.....	18,732		181	50,378	2,402,300	1,095,900	422,600
Esmeralda.....	1,683		1,478	3,853		2,000	
Eureka.....	434	1,980	330	7,015	80,000	128,100	160,800
Humboldt.....	199			69	15,000		
Lander.....	7,426	1,810	804	47,617	554,800	218,000	4,000
Lincoln.....	12,061		317	160,257	314,400	1,497,600	603,600
Lyon.....	8,158		49	1,876	634,000		
Mineral.....	1,104		53	5,329	68,000	6,000	
Nye.....	9,065		1,240	124,115	4,000	443,500	34,500
Pershing.....	13,808		189	25,317	1,060,000	53,100	
Washoe.....	27		1	184		1,700	800
White Pine.....	91,406		986	32,938	14,062,100	585,900	1,765,400
Total, 1943.....	169,471	4,617	5,421	503,214	19,252,600	5,018,800	4,855,200
	140,603	4,110	7,867	566,330	17,866,200	3,735,600	1,992,900

BY CLASSES OF MATERIAL

Dry and siliceous gold.....	1,939	1,980	2,162	9,133	79,600	81,700	
Dry and siliceous gold-silver.....	5,587		1,321	101,378	2,000	21,900	
Dry and siliceous silver.....	3,520		218	76,330	4,100	166,700	4,100
Copper.....	125,006	1,310	1,142	63,479	18,884,400	29,000	
Lead.....	13,993		503	163,428	25,900	2,655,300	6,900
Zinc.....	7,739		72	13,207	25,600	251,200	2,210,000
Zinc-lead.....	11,687	1,327	103	86,359	228,000	1,903,000	2,134,200
	169,471	4,617	5,421	503,214	19,252,600	5,018,800	4,355,200

¹ Includes 9,245,700 pounds of copper from precipitates.

² Includes 8,865,300 pounds of copper from precipitates.

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1944, by counties and districts, in terms of recovered materials¹

County and district ¹	Mines producing ²		Ore and old tailings		Gold		Silver (lode and placer) ³	Copper	Lead	Zinc	Total value
	Lode	Placer	Short tons	Fine ounces	Lode	Placer					
Churchill County:											
Fairview.....	1		1,601	41			Fine ounces 5,103	Pounds 194,000		Pounds	\$30,584
Holy Cross.....	1		4	1			998				723
Clark County:											
Eldorado Canyon.....	1		31	27			215				1,098
Searchlight.....	4		52	21			308	5,200	2,100		1,824
Yellow Pine.....	13		4,958	53			28,772	62,800	793,900	1,364,000	249,801
Elko County:											
Alabama.....	1		118	3			187	6,800			1,156
Contact.....	5		7,855	82			5,034	398,200	1,800		61,062
Cope.....	(1)		(1)				(1)	(1)			670
Delano.....	3		1,806	2			39,098	8,000	532,500	600	72,076
Jarbridge.....	1		1	15			17				187
Merrimac.....	1		2,790	5			27,337	2,000	169,400	171,400	52,144
Railroad.....	3		586	1			1,367	16,400	50,800		7,160
Ruby Valley.....	1		253				69		12,400	48,000	6,553
Spruce Mountain.....	1		2,514	16			9,900	22,200	512,600	422,000	94,713
Esmeralda County:											
Desert.....	1		1				48				69
Divide.....	1		1,195	800			3,040		400		30,162
Goldfield.....	1		41	49			69		1,600		1,796
Silver Peak.....	4		446	628			696				22,603
Eureka County:											
Cortez.....	1		213	32			1,554		7,000	9,200	3,884
Eureka.....	5		5,171	347			11,392	80,000	199,000	390,800	91,517
Humboldt County:											
Awakening.....	3		231	162			97				5,739
Gold Run.....	1		199	5			69				175
Red Butte.....	1							15,000			2,074

¹ Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnote 9 and their output included under "Other districts."² Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.³ Source of total silver as follows: 1,256,732 ounces from lode mines and 2,904 from placers.⁴ Included under "Other districts."⁵ Output from property not classed as a "mine."⁶ Exclusive of lode output, which is included under "Other districts."

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1944, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore and old tailings	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
Lander County:			Short tons	Fine ounces	Fine ounces	Fine ounces	Fine ounces	Pounds	Pounds	Pounds	
Battle Mountain.....	7	(*)	85,099	6,332	2	6,334	138,444	1,651,800	218,000	4,000	\$561,028
Kingston.....	1		16	14		14	62				534
McCoy.....	1		177	233		233	163	200			8,298
New Pass.....	1		200	107		107	17				3,767
Lincoln County:											
Comet.....	1		1,171	58		58	2,413	800	22,300	5,500	6,265
Groom.....	1		1,146	3		3	6,040		444,000		39,920
Jack Rabbit.....	1		8,168	34		34	59,639	311,600	598,700	603,600	202,372
Pioche.....	9		212,381	3,235		3,235	444,309	13,600	8,111,000	35,966,900	5,180,121
Lyon County: Yerington.....	5		8,158	49		49	1,876	634,000			58,639
Mineral County:											
Garfield.....	1		36	46		46	4,618		6,000		5,374
Marlette.....	1		8	6		6					5,210
Silver Star.....	3		676	8		8	208	33,400			4,937
Nye County:											
Manhattan.....	3	4	329	395	7,294	7,689	3,150				271,355
Quartz Mountain.....	2		114	6		6	872	200	15,400		2,089
Silver Bow.....	1		15	1		1	232				200
Tonopah.....	5		4,121	1,029		1,029	91,215				100,879
Union.....	2		1,646	15		15	8,765	2,800	139,300		18,280
Willow Creek.....	1		12	1		1	381		7,700	400	968
Pershing County:											
Aldrich.....	2		85	2		2	1,596	200	19,000		2,752
Antelope.....	1		13,575	117		117	22,358	1,059,800	1,200		163,163
Arabis.....	1		142	4		4	1,346		32,900		8,729
Central.....	1		1	11		11	914				396
Nightingale.....	1		(7)	1		1	14		900		757
Rochester.....	3	3			26	26	7				915
Seven Troughs.....	3		121	436		436	758				15,799
Unionville.....	1				2	2					70
Willow Creek.....	5	1	56,157	3,655	20	3,655	44,065				707
Storey County: Comstock.....											159,280
Washoe County:											
Galena.....	1		4,404	28		28	8,415	16,000	130,300	511,200	77,825
Pavine.....	1		27	1		1	184		1,700	800	77,393
White Horse.....	1		12	65		65	24				2,292

CHURCHILL COUNTY

Fairview district.—Lowell Thompson shipped lead ore to a smelter from the Chalk Mountain mine during 1944.

CLARK COUNTY

Yellow Pine (Goodsprings) district.—The Argenta Consolidated Mining Co. worked the Argenta mine throughout 1944; 607 tons of zinc ore containing 5 ounces of gold, 3,767 ounces of silver, 1,527 pounds of copper, 51,991 pounds of lead, and 247,577 pounds of zinc were shipped to a smelter; in addition, the company shipped 1,310 tons of oxidized zinc ore to the Metals Reserve Company stock pile at Jean. The Diamond Gold Mining Co. and Jay Jacobson worked the Green Monster mine during 1944 and shipped to a smelter 152 tons of zinc-lead ore containing 323 ounces of silver, 408 pounds of copper, 29,623 pounds of lead, and 59,414 pounds of zinc; in addition, 2,800 tons of oxidized zinc ore containing approximately 20 percent zinc and 3 percent lead were shipped to the Metals Reserve Company stock pile at Jean. The Root Zinc Lease worked the Root Zinc mine throughout 1944; 119 tons of zinc ore containing 426 ounces of silver, 109 pounds of copper, 8,783 pounds of lead, and 74,407 pounds of zinc were shipped to a smelter; in addition, 350 tons of oxidized zinc ore were shipped to the Metals Reserve Company stock pile at Jean. T. J. Hammond and R. H. Reed shipped zinc-lead ore to a smelter from the Seabiscuit mine during 1944. L. F. Jacobson worked the Sultan mine during 1944; 1,042 tons of zinc-lead ore containing 7 ounces of gold, 9,884 ounces of silver, 1,380 pounds of copper, 196,520 pounds of lead, and 437,309 pounds of zinc were shipped to a smelter; in addition, 705 tons of oxidized zinc ore were shipped to the Metals Reserve Company stock pile at Jean. The Coronado Copper & Zinc Co. shipped zinc ore, zinc-lead ore, and zinc-lead old tailings from the Yellow Pine mine during 1944.

ELKO COUNTY

Contact (Salmon River) district.—The Marshall Mining Co. shipped copper ore from the Delano and Allen mines during 1944. E. A. Yadon, a lessee, operated the Queen of the Hills mine from May 30, 1944, until the end of the year; 179 tons of copper ore containing 194 ounces of silver and 28,772 pounds of copper were shipped to a smelter.

Cope (Mountain City) district.—The Mountain City Copper Co. (again the third-largest copper producer in Nevada) was active throughout 1944; part of the ore was treated in the company 400-ton flotation mill, and high-grade copper ore was shipped for direct smelting.

Delano district.—The American Smelting & Refining Co. worked the Cleveland mine from January 1 to December 31, 1944, when operations were terminated because development had failed to yield expected results; substantial shipments of lead ore were made to the company Murray smelter during the year. C. E. Roak shipped lead ore to a smelter from the Gold Note mine during 1944. Tooley & McDonley worked the Net mine from January 1 to September 30, when labor shortage forced suspension of the operation; 599 tons of lead ore containing 6 ounces of gold, 9,358 ounces of silver, 562 pounds of copper, and 176,037 pounds of lead were shipped to a smelter.

Merrimac district.—The Rip Van Winkle Consolidated Mining Co. treated the Rip Van Winkle mine from January 1 to November 1, 1944. Inability to obtain labor resulted in suspension of the operation. Lead ore was treated in the company 100-ton flotation mill, and lead concentrate and zinc concentrate were shipped to smelters.

Redwood district.—L. D. Foreman & Co. shipped material from the Redwood slag dump to a lead smelter during 1944.

Spruce Mountain district.—Silver ore was shipped to a smelter by the Missouri Monarch Consolidated Mines Co. from the Blackfoot mine during 1944. Eugene Parker operated the Humbug mine and shipped 113 tons of lead ore containing 325 ounces of silver, 147 pounds of copper, and 28,691 pounds of lead to a smelter during the year.

ESMERALDA COUNTY

Divide district.—The Tonopah Divide Mining Co., through lessees, operated the Tonopah Divide mine throughout 1944; 1,195 tons of ore containing 800 ounces of gold and 3,040 ounces of silver were shipped to a smelter.

Silver Peak district.—Fred Vollmar shipped gold ore to a smelter from the Mary mine during 1944.

EUREKA COUNTY

Cortez district.—Joe McCarthy operated the Majestic (Mill Canyon) mine owned by the Roberts Mining & Milling Co. and treated gold-silver ore by flotation. Lead concentrate and zinc concentrate were shipped to a smelter.

Eureka district.—The Callahan Zinc-Lead Co. carried on a development campaign at the Mount Hope mine throughout 1944; 2,757 tons of zinc ore were shipped to the Combined Metals Reduction Co. Bauer mill in Utah, where 241 tons of lead concentrate containing 16 ounces of gold, 3,822 ounces of silver, 76,788 pounds of lead, and 2,174 pounds of zinc and 288 tons of zinc concentrate containing 1 ounce of gold, 555 ounces of silver, 4,782 pounds of lead, and 306,956 pounds of zinc were recovered. In addition the company stock-piled ore for treatment when its 200-ton flotation mill, moved from Arizona and under construction at the new site during the year, is ready for operation. The Mountain View Mining Co. operated the Mountain View mine throughout 1944 and shipped 279 tons of zinc ore containing 18,964 pounds of lead and 184,305 pounds of zinc to a smelter. The Eureka Corporation, Ltd., was engaged in developing the Richmond-Eureka mine throughout 1944; old speiss, treated principally for arsenic but yielding also gold, silver, copper, and lead, was shipped to a smelter.

HUMBOLDT COUNTY

Awakening district.—Austin Bros. Gold Mining Co. treated gold ore from the Jumbo mine by amalgamation during 1944.

Potosi district.—Gatchell Mine, Inc., treated gold ore from the Gatchell mine in a 1,000-ton cyanide plant. The arsenic content of the ore, which had required installation of expensive roasting equipment, proved most welcome when War Production Board Order L-208 went into effect because this property was permitted to continue operations as a producer of strategic arsenic. The company tungsten production program was terminated on June 20, 1944.

LANDER COUNTY

Battle Mountain district.—The International Smelting & Refining Co. operated its 350-ton flotation mill at the Copper Canyon mine throughout 1944. In addition to copper concentrates, crude copper ore and old tailings were shipped to smelters. Lessees worked the Copper Queen mine throughout the year; 1,123 tons of copper ore containing 6 ounces of gold, 148 ounces of silver, and 55,093 pounds of copper were shipped to a smelter. Hogle Bros. worked the Nevada mine from January 1 to June 30 and shipped 220 tons of lead ore containing 50 ounces of gold, 3,097 ounces of silver, 332 pounds of copper, 86,126 pounds of lead, and 5,171 pounds of zinc to a smelter. Symanzik & Wrobel worked the Trinity mine throughout 1944; 1,558 tons of silver ore containing 133 ounces of gold, 29,433 ounces of silver, 3,107 pounds of copper, and 134,590 pounds of lead and 310 tons of lead ore containing 28 ounces of gold, 9,115 ounces of silver, 531 pounds of copper, and 48,514 pounds of lead were shipped to a smelter.

Bullion district.—Willow Creek Mines, Inc., worked the Goldacres mine throughout 1944. Ore mined by open-pit methods was treated at the company 300-ton cyanide mill.

McCoy district.—Johnson & Uren worked the Gold Dome mine and shipped 177 tons of ore containing 233 ounces of gold, 163 ounces of silver, and 400 pounds of copper to a smelter.

New Pass district.—Smith & Snyder worked the Thomas W. mine throughout 1944 and amalgamated 200 tons of ore which yielded 107 ounces of gold and 17 ounces of silver.

LINCOLN COUNTY

Comet district.—Comet Mines, Inc., worked the Comet mine from January 1 to December 12; 1,071 tons of gold-silver ore treated by flotation yielded 21 tons of zinc-lead concentrate containing 19 ounces of gold, 867 ounces of silver, 454 pounds of copper, 5,573 pounds of lead, and 7,662 pounds of zinc. In addition, 100 tons of lead ore containing 39 ounces of gold, 1,546 ounces of silver, 430 pounds of copper, and 22,454 pounds of lead were shipped for direct smelting.

Groom district.—The International Mining Corp. worked the Groom mine from April 15 to December 31; 1,146 tons of ore containing 3 ounces of gold, 6,040 ounces of silver, and 461,960 pounds of lead were shipped to a smelter. The company 50-ton flotation mill was idle because of the labor shortage.

Jack Rabbit district.—The Bristol Silver Mines Co. shipped zinc-lead ore and copper ore to smelters during 1944.

Pioche district.—The Combined Metals Reduction Co. operated its 500-ton flotation mill on company and custom ore throughout 1944. This mill's capacity was expanded and reached 1,000 tons of ore daily at the end of the year; however, labor shortages at the mines supplying ore resulted in some of the new capacity remaining unutilized. Company ore for the mill was derived from the Abe Lincoln, Amalgamated Pioche, Pioche 802 and Raymond Ely West mines, also called the Pioche Nos. 1 and 2 group. Mill products were lead concentrate and zinc concentrate which were shipped for further treatment. In addition to company-produced ore the Combined Metals Pioche mill treated 72,544 tons of zinc ore mined by Ely Valley Mine and a smaller quantity of zinc ore mined by the Prince Consolidated

Mining Co.—The Salt Lake-Pioche Mining Co. worked the Apex and Financier mines throughout 1944; 1,062 tons of silver ore containing 31 ounces of gold, 36,028 ounces of silver, 333 pounds of copper, and 74,378 pounds of lead were shipped to a smelter from the Apex mine. In addition, 130 tons of lead ore containing 8 ounces of gold, 8,758 ounces of silver, and 15,771 pounds of lead were shipped. The production from the Financier mine, which was leased to Free Bros., totaled 1,175 tons of lead ore containing 113 ounces of gold, 46,130 ounces of silver, 427 pounds of copper, and 382,587 pounds of lead. The Queen Mining Co. shipped 270 tons of gold-silver ore containing 59 ounces of gold, 2,116 ounces of silver, 1,878 pounds of copper, and 15,606 pounds of lead from the Highland Queen mine before inability to hire miners forced a suspension of operations.

LYON COUNTY

Yerington district.—During 1944 lessees working the Mason Valley mine shipped 3,920 tons of copper ore containing 22 ounces of gold, 983 ounces of silver, and 389,592 pounds of copper. Angelus Basic Copper shipped 1,568 tons of copper ore containing 11 ounces of gold, 313 ounces of silver, and 110,718 pounds of copper from the Northern Lights mine. Western Nevada Mining Co. shipped 2,347 tons of copper ore containing 15 ounces of gold, 515 ounces of silver, and 121,998 pounds of copper from the Western Nevada mine. The International Smelting & Refining Co. continued its exploration and development campaign at the Gelder property during the year; no production was reported.

NYE COUNTY

Manhattan district.—Lessees operated the Manhattan mine from May 1 to December 31. The Manhattan Gold Dredging Co., only large producer of placer gold in the State in 1944, operated a connected-bucket dredge from January 1 to March 14 and from July 25 to December 31 under grant by the War Production Board. The dredge was equipped with 108 $9\frac{1}{4}$ -cubic foot buckets.

Tonopah district.—Several sets of lessees worked parts of the Tonopah Mining Co. of Nevada property throughout 1944 and shipped gold-silver ore to a smelter. The West End Consolidated Mines Corp. shipped 665 tons of gold-silver ore containing 108 ounces of gold and 9,259 ounces of silver to a smelter from the West End mine.

Tybo district.—Hall Bros. Co., Inc., worked the Tybo group of mines throughout the year and shipped lead ore and zinc-lead ore for treatment at smelters and custom flotation plants.

Union district.—L. D. Foreman & Co. shipped dump ore and old slag from Downeyville to a smelter.

PERSHING COUNTY

Antelope (Majuba) district.—Greenan-Kerr Tin Mine shipped to a smelter 13,575 tons of copper ore containing 117 ounces of gold, 22,358 ounces of silver, 1,081,430 pounds of copper, and 1,901 pounds of lead.

Arabia district.—Lessees operating the C. W. and G. D. B. mine shipped to a smelter 142 tons of lead ore containing 4 ounces of gold, 1,346 ounces of silver, 108 pounds of copper, and 34,080 pounds of lead.

Seven Troughs district.—Earl Tucker treated ore by amalgamation at the Portland mine.

STOREY COUNTY

Comstock district.—The Virginia City Mining Co. operated the Consolidated Virginia mine from March 27 to August 26, 1944, and shipped gold-silver ore to a cyanide mill for treatment. A small quantity of gold and silver was recovered during a mill clean-up carried on by the Sutro Tunnel Coalition, Inc., at the Crown Point and Yellow Jacket mines. The Central Comstock Mines Corp. operated its 100-ton countercurrent cyanide plant from September 10 to November 1 on ore mined at the Savage, Hale and Norcross, Chollar, and Potosi mines.

WASHOE COUNTY

Galena district.—The Union Lead Mining & Smelting Co. treated ore from the Union Lode mine by jig concentration and flotation and shipped gold-silver concentrates, lead-copper concentrates, and zinc concentrates to smelters and to custom concentrators for selective flotation.

White Horse (Olinghouse) district.—Lessees treated 12 tons of ore by amalgamation at the Texas No. 2 lode mine and recovered 65 ounces of gold and 24 ounces of silver.

WHITE PINE COUNTY

Aurum (Silver Mountain) district.—The Grand Deposit Mining Co. operated the Grand Deposit mine throughout 1944 and shipped 1,118 tons of copper ore containing 14 ounces of gold, 4,178 ounces of silver, 93,535 pounds of copper, and 8,050 pounds of lead; 38 tons of lead ore containing 1 ounce of gold, 196 ounces of silver, 400 pounds of copper, and 5,358 pounds of lead; and 2,492 tons of zinc ore containing 4 ounces of gold, 1,292 ounces of silver, 33,213 pounds of copper, 43,836 pounds of lead, and 897,840 pounds of zinc. During July all the surface equipment was destroyed by fire, but reconstruction was nearly complete at the end of the year.

Robinson (Ely) district.—The Nevada Mines Division of the Kennecott Copper Corp. worked the Copper Flat pit and the Ruth mine throughout 1944. This corporation also operated the McGill flotation concentrator (daily capacity, 20,000 tons) and the McGill copper smelter, both at McGill, where the product of its mines and that of the Consolidated Coppermines Corp. were treated. This company, largest privately financed industrial organization in Nevada, was the leading producer of copper in the State and stood second in production of gold and silver. The Consolidated Coppermines Corp., second-largest copper and third-largest gold producer in the State in 1944, was active throughout the year. Operations by both companies were severely curtailed by labor shortage. Sam Robison shipped to a smelter from the Columbia mine 3,867 tons of zinc ore containing 63 ounces of gold, 7,669 ounces of silver, 19,063 pounds of copper, 151,321 pounds of lead, and 1,236,060 pounds of zinc. L. D. Foreman & Co. shipped material from the King old slag dump. W. M. and H. T. Farnsworth shipped gold-silver ore and lead ore from the Monarch mine.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO

(MINE REPORT)

By RICHARD H. MOTE

SUMMARY OUTLINE

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SUMMARY

New Mexico zinc production was larger in quantity in 1944 than in any previous year except record-making 1943, and output of lead was the largest in quantity since 1935. However, except for 1943, gold production was the lowest since 1880 and silver since 1926. Although the output of copper was less than in 1943, it was greater than in any year prior to 1940.

Comparing 1944 with 1943, gold increased 24 percent and silver 15 percent in both quantity and value; lead increased 27 percent in quantity and 35 percent in value; copper decreased 8 percent in quantity and 5 percent in value; and zinc decreased 15 percent in quantity and 10 percent in value. The total value of the five metals was 5 percent less than in 1943; and, of the total, copper represented 38 percent, zinc 36, lead 4, and silver and gold each 1 percent.

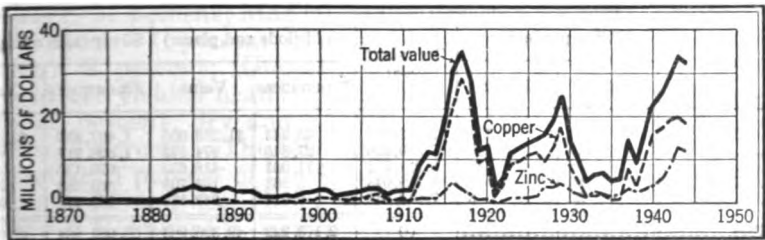


FIGURE 1.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico, 1870-1944. The value of gold, silver, and lead produced annually has been relatively small.

Grant County continued to be the largest contributor to the metal-mining output of New Mexico; it produced 92 percent of the State total value and stood first in the output of each of the 5 metals. Socorro County produced 4 percent of the State total value and ranked second to Grant County in production of lead and zinc. Hidalgo County contributed 3 percent and was second to Grant County in production of gold, silver, and copper. Of the 10 counties producing

in New Mexico in 1944, these 3 furnished over 99 percent of the State total value of the 5 metals.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ⁴	Zinc ⁵
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940.....	\$35.00	\$0.711+	\$0.113	\$0.050	\$0.063
1941.....	35.00	¢.711+	.118	.057	.075
1942.....	35.00	¢.711+	.121	.067	.093
1943.....	35.00	¢.711+	.130	.075	.108
1944.....	35.00	¢.711+	.135	.080	.114

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was \$20.67+(\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price includes bonus payments by Metals Reserve Company for overquota production.

⁴ \$0.7111111.

The following table shows the number of mines in New Mexico producing gold, silver, copper, lead, and zinc and their annual output of ore and metals from 1940 to 1944, as well as the total production from 1848 to 1944. The report of this series for 1929 (chapter of Mineral Resources of the United States, 1929, pt. 1, pp. 729-759) gives the yearly production of each important metal-producing district in New Mexico from 1904 to 1929, inclusive. Subsequent records year by year may be found in annual issues of Mineral Resources and Minerals Yearbook.

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1940-44, and total, 1848-1944, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1940.....	164	179	7,089,903	35,943	\$1,258,005	1,407,839	\$1,001,130
1941.....	145	103	7,530,226	27,845	974,575	1,328,317	944,581
1942.....	78	48	8,221,512	11,961	418,635	676,170	480,832
1943.....	64	16	8,329,043	5,563	194,705	463,583	329,659
1944.....	55	3	7,943,846	6,918	242,130	535,275	380,640
1848-1944.....			(1)	2,173,222	49,396,963	66,951,604	52,341,337

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1940.....	139,696,000	\$15,785,648	7,644,000	\$382,200	60,626,000	\$3,819,438	\$22,246,421
1941.....	146,956,000	17,340,808	9,336,000	532,152	75,724,000	5,679,300	25,471,416
1942.....	160,200,000	19,384,200	9,216,000	617,472	92,922,000	8,641,746	29,542,885
1943.....	152,326,000	19,802,380	11,446,000	858,450	119,048,000	12,857,184	34,042,378
1944.....	139,460,000	18,827,100	14,530,000	1,162,400	101,454,000	11,566,756	32,178,026
1848-1944.....	¹ 1,243,437	366,892,663	² 262,280	26,170,053	³ 768,542	107,951,210	602,752,226

¹ Figures not available.

² Short tons.

Gold and silver produced at placer mines in New Mexico, 1940-44, in terms of recovered metals

Year	Gold		Silver		Total value	Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value			Fine ounces	Value	Fine ounces	Value	
1943	2,928	\$102,480	263	\$187	\$102,667	1943	92	\$3,220	25	\$18	\$3,238
1944	2,488	87,080	284	202	87,282	1944	8	280			280
1945	1,247	43,645	135	96	43,741						

Gold.—Mine production of recovered gold in New Mexico increased from 5,563 fine ounces in 1943 to 6,918 ounces in 1944. The principal gold-producing districts in 1944 were: Central, Grant County, which produced 34 percent of the State output of recovered gold; Lordsburg, Hidalgo County, 33 percent; Mogollon, Catron County, 15 percent; Willow Creek (Terrero), San Miguel County, 8 percent; Steeple Rock, Grant County, 4 percent; Pinos Altos, Grant County, 3 percent; and Magdalena, Socorro County, 2 percent. Copper ore yielded 37 percent of the State total gold; zinc-lead ore, 33 percent; dry and siliceous ores, 21 percent; and lead and zinc ores, 9 percent. The principal producers in 1944, in order of output, were as follows: The Banner Mining Co. in Hidalgo County, United States Smelting, Refining & Mining Co. (Bullfrog mine) in Grant County, Silver Creek Mining Co. in Catron County, Atwood mine in Hidalgo County, Terrero Mining Co. (Pecos mine) in San Miguel County, New Mexico Ore Processing Co. (Peerless mine) in Grant County, Boston Bicket mine in Grant County, Exploration Syndicate, Inc. (Carlisle mine) in Grant County, and Kennecott Copper Corp. (Chino mine) in Grant County; these five properties produced 90 percent of the State total output of gold.

Silver.—Mine production of recovered silver in New Mexico increased from 463,583 fine ounces in 1943 to 535,275 ounces in 1944. The Central district contributed 40 percent of the State total in 1944; Lordsburg, 21 percent; Magdalena, 12 percent; Mogollon, 11 percent; Steeple Rock, 4 percent; Pinos Altos, 3 percent; Willow Creek (Terrero), 2 percent; Kingston, 2 percent; and Swartz, 2 percent. Zinc-lead ore yielded nearly 63 percent of the total silver; copper ore, nearly 22 percent; dry and siliceous ores, 12 percent; and lead and zinc ores, 4 percent. The following 10 producers, in order of output, contributed 81 percent of the State total: The United States Smelting, Refining & Mining Co. (Bullfrog mine) in Grant County, American Smelting & Refining Co. (Ground Hog Unit) in Grant County, Silver Creek Mining Co. in Catron County, Atwood mine in Hidalgo County, Banner Mining Co. in Hidalgo County, American Smelting & Refining Co. (Magdalena Unit) in Socorro County, New Mexico Ore Processing Co. (Peerless mine) in Grant County, Peru Mining Co. (Copper Flat, Kearny, and Pewabic mines) in Grant County, Exploration Syndicate, Inc. (Carlisle mine) in Grant County, and Empire Zinc Co. (Kelly mine) in Socorro County.

Copper.—Mine production of recovered copper in New Mexico in 1944 was 139,460,000 pounds, a decrease of 8 percent from 1943. The Chino open-pit mine of the Kennecott Copper Corp. at Santa Rita.

Grant County, continued to be by far the largest copper producer in the State; the second-largest continued to be the Banner Mining Co., south of Lordsburg, Hidalgo County; and other substantial producers (in order of output) were the Burro Mountain group of the Phelps Dodge Corp. at Tyrone, Grant County, and the Stauber mine near Pastura, Guadalupe County. Copper ore and precipitates from mine water and leached dumps yielded 99 percent of the total copper; virtually all the remainder was recovered from concentrates produced by the milling of lead, zinc, and zinc-lead ores.

Lead.—Substantial gains in production of lead in the Central district, Grant County, and the Magdalena district, Socorro County, were responsible for the increased lead output in New Mexico in 1944. Lead production from the Central district was the largest in the history of the district, and production from the Magdalena district was the largest since 1917. Grant County contributed 71 percent of the State total lead in 1944; Socorro County produced 22 percent. Four properties—the American Smelting & Refining Co. Ground Hog (ranking first in output) and Magdalena (third) Units, the United States Smelting, Refining & Mining Co. Bullfrog mine (second), and the New Mexico Ore Processing Co. Peerless property (fourth)—produced 60 percent of the total output during the year. Zinc-lead ore yielded over 89 percent of the total lead; lead ore, more than 9 percent; copper ore, 1 percent; and zinc ore and dry and siliceous ores, less than 0.5 percent.

Lead concentrates produced in 1944 amounted to 12,025 tons containing, as shipped, 1,397 ounces of gold, 219,902 ounces of silver, 927,591 pounds of copper, 12,137,352 pounds of lead, and 1,879,763 pounds of zinc; the average lead content was 50.47 percent.

Zinc.—Nearly 91 percent of the total recovered zinc produced in New Mexico in 1944 came from Grant County; virtually all the remainder came from the Magdalena district, Socorro County. The principal producers in 1944, in order of output, were the United States Smelting, Refining & Mining Co. (Bullfrog mine), Peru Mining Co. (Copper Flat, Kearny, and Pewabic mines), Empire Zinc Co. (Hanover mine group), and American Smelting & Refining Co. (Ground Hog Unit), all in the Central district, Grant County; American Smelting & Refining Co. (Magdalena Unit), Magdalena district, Socorro County; Black Hawk Consolidated Mines Co. (Hobo mine), Central district, Grant County; Empire Zinc Co. (Kelly mine), Magdalena district, Socorro County; and New Mexico Ore Processing Co. (Peerless mine), Central district, Grant County. Zinc-lead ore yielded 98 percent of the total zinc, and the remaining 2 percent came from zinc ore.

Zinc concentrates produced in 1944 amounted to 107,556 tons compared with 127,748 tons in 1943. The metal content, as shipped, was 1,073 ounces of gold, 133,031 ounces of silver, 1,097,167 pounds of copper, 2,442,940 pounds of lead, and 117,084,131 pounds of zinc. The average zinc content of concentrates was 54.43 percent in 1944 compared with 53.70 percent in 1943.

MINE PRODUCTION BY COUNTIES

Production of gold, silver, copper, lead, and zinc in New Mexico in 1944, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Alameda	1		1,069	\$37,415	61,349	\$43,626
Chavez		2	3	105		
Crowley	2				180	128
Doña Ana	29		2,850	99,750	268,307	190,796
Grant	1				308	219
Hidalgo	9		2,817	81,095	115,051	81,814
Lincoln	1		528	18,480	11,593	8,244
McKinley	2		8	105	599	426
Mohave	4	1	20	700	11,807	8,396
Navajo	6		128	4,480	66,081	46,991
San Juan	55	3	6,918	242,130	535,275	380,640
Total, 1944	64	16	5,563	194,705	463,583	329,659

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Alameda	1,000	\$135					\$81,176
Chavez							105
Crowley	400	54	1,200	\$96			278
Doña Ana	133,814,000	18,064,890	10,383,000	830,640	92,197,000	\$10,510,458	29,696,534
Grant	595,000	80,325					80,544
Hidalgo	4,718,000	636,930	349,000	27,920	78,000	8,892	836,651
Lincoln	55,400	7,479	418,000	33,440	43,000	4,902	72,545
McKinley	1,200	162	37,800	3,024	57,000	6,498	10,215
Mohave	30,000	4,050	101,000	8,080	131,000	14,934	36,160
Navajo	245,000	33,075	3,240,000	259,200	8,948,000	1,020,072	1,363,818
San Juan	139,460,000	18,827,100	14,530,000	1,162,400	101,454,000	11,565,756	32,178,026
Total, 1944	152,326,000	19,802,380	11,446,000	858,450	119,048,000	12,857,184	34,042,378

Gold or treated and gold and silver produced at lode mines in New Mexico in 1944, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Alameda	1,842	1,069	61,349	Santa Fe	447	3	599
Chavez	12		180	Sierra	1,258	15	11,907
Crowley	7,730,912	2,850	268,307	Socorro	65,331	128	66,081
Doña Ana	8,864		308				
Grant	132,975	2,817	115,051		7,943,846	6,910	535,275
Hidalgo	2,185	528	11,593	Total, 1943	8,329,043	5,471	463,558

MINING INDUSTRY

The metal-mining industry of New Mexico was encumbered in 1944 by the hectic conditions accompanying the Nation's third year of World War II. The most significant factor affecting the production of metals was the desperate shortage of manpower. During the latter part of the year this shortage was more critical than at any time since the entry of the United States into the war. Even more serious than the lack of skilled labor was the inability of the industry to conduct mining and development simultaneously. Several operators found it advisable to curtail their efforts to meet war demands for peak pro-

duction in favor of development programs to assure adequate ore reserves for future operations. Absenteeism continued to hamper the major producers, for even under the most favorable underground working conditions it was reported as high as 20 percent. The withdrawal of deferments of young mine workers pointed to a greater need for manpower at the battle fronts, a sharp contrast to 1943 when soldiers were returned to the mines to augment the dwindling labor supply.

The general policy of the Quota Committee pertaining to the premium-price plan for overquota production of domestic copper, lead, and zinc as revised in 1943 prevailed throughout 1944. The latter part of the year found the producers increasingly apprehensive over the continuance of premiums on these three metals. Specific concern was evident over the 30-day cancellation clause of all except the basic A premium.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in New Mexico in 1944, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore.....	182	395	284	1,400	1,750	-----
Dry and siliceous gold-silver ore.....	1,866	1,071	61,527	1,180	-----	-----
Dry and siliceous silver ore.....	217	-----	1,024	6,304	12,343	-----
	2,265	1,466	62,835	8,884	14,093	-----
Copper ore.....	7,207,554	2,543	115,261	137,691,710	178,511	-----
Lead ore.....	4,277	636	20,279	50,385	1,363,506	-----
Zinc ore.....	6,332	2	1,244	9,956	17,339	1,549,559
Zinc-lead ore.....	723,418	2,263	335,656	1,699,065	12,956,551	99,904,441
	7,941,581	5,444	472,440	139,451,116	14,515,907	101,454,000
Total, lode mines.....	7,943,846	6,910	535,275	139,460,000	14,530,000	101,454,000
Total, placers.....	-----	8	-----	-----	-----	-----
	7,943,846	6,918	535,275	139,460,000	14,530,000	101,454,000
Total, 1943.....	8,329,043	5,563	463,583	152,326,000	11,448,000	119,048,000

¹ Includes 23,936,645 pounds of copper recovered from precipitates from mine water and leached dumps.

² Includes 27,744,537 pounds of copper recovered from precipitates from mine water and leached dumps.

METALLURGIC INDUSTRY

Of the 7,943,846 tons of ore mined in 1944 in New Mexico, 7,850,208 tons (99 percent) were treated at concentration plants, and 93,638 tons (1 percent) were shipped crude to smelters. Copper ore sold or treated decreased from 7,571,937 tons in 1943 to 7,207,554 tons in 1944, zinc ore from 361,391 to 6,332, and dry and siliceous ores from 2,916 to 2,265; zinc-lead ore increased from 392,153 to 723,418, and lead ore from 586 to 4,277 tons.

Flotation was employed at all concentrating mills; of the ore (7,850,208 tons) treated, 7,120,423 tons were copper ore, 723,418 tons zinc-lead ore, 6,257 tons zinc ore, and 110 tons lead ore. Flotation mills in operation during the year were: Chino at Hurley; Empire

East Hanover; Hanover Unit near Hanover; Bullfrog near Vancou-
 ver; Banner near Lordsburg; Peru near Deming; Magdalena Unit
 near Magdalena; Continental at Silver City; Southwestern near
 Tucson, Ariz. (operating on ore from the Carlisle group in the Steeple
 Rock district, Grant County); and East Camp at Steeple Rock. The
 reverberatory smelter of the Kennecott Copper Corp. at Hurley
 was operated throughout 1944 on company copper concentrates,
 precious copper ore, and copper precipitates recovered from leaching
 waste dumps. Copper precipitates from company operations at
 Silver City, Ariz., were treated also. Most of the copper produced at the
 smelter in 1944 was marketed in the form of fire-refined copper bars.
 The Exploration Syndicate, Inc., completed conversion of the East
 Camp cyanide mill to selective flotation (daily capacity, 125 tons) in
 September. Before conversion of the mill, ore was treated at the
 Northwestern Minerals Co. mill at Duncan, Ariz.

In March the New Mexico Ore Processing Co. purchased the Con-
 tinental Chemical & Ore Co. mill at Silver City. The new owners
 increased the capacity of the plant from 60 tons per day to 100, built
 a new assay office and metallurgical laboratory, and installed addi-
 tional ore bins.

*Mine production of metals in New Mexico in 1944, by methods of recovery, in terms
 of recovered metals*

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Concentrates smelted.....	346, 165	4, 031	389, 059	137, 170, 486	13, 003, 780	101, 392, 994
Waste dumps.....	93, 638	2, 879	146, 216	2, 289, 514	1, 526, 220	61, 006
Total 1944.....		6, 918	535, 275	139, 460, 000	14, 530, 000	101, 454, 000
		5, 563	463, 583	152, 326, 000	11, 446, 000	119, 048, 000

¹Includes 23,936, 645 pounds of copper recovered from smelting of precipitates from mine water and
 waste dumps.

*Gross metal content of concentrates (all produced at concentrating mills) from ores
 mined in New Mexico in 1944, by classes of concentrates smelted*

Class of concentrates	Concen- trates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (wet assay) (pounds)	Lead (wet assay) (pounds)	Zinc (pounds)
Copper.....	224, 475	8, 381	135, 669	138, 341, 148	37, 451	-----
Lead.....	12, 025	1, 397	219, 902	927, 591	12, 137, 352	1, 879, 763
Waste copper.....	2, 109	55	21, 819	188, 434	534, 645	-----
Total 1944.....	107, 556	1, 073	133, 031	1, 097, 167	2, 442, 940	117, 084, 131
	346, 165	10, 906	510, 421	140, 554, 340	15, 152, 388	118, 963, 894
	360, 796	10, 165	503, 582	153, 119, 483	13, 392, 384	138, 872, 627

¹Includes 24,449,757 pounds of copper contained in precipitates from mine water and leached dumps.

²Includes 28,330,951 pounds of copper contained in precipitates from mine water and leached dumps.

Mine production of metals from concentrating mills in New Mexico in 1944, in terms of recovered metals

BY COUNTIES

	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concen- trates pro- duced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Grant	7,659,778	324,905	2,342	262,902	¹ 132,667,781	9,632,204	92,178,99
Hidalgo	123,777	8,397	1,552	49,292	4,235,568	44,994	78,00
Santa Fe	447	95	3	599	1,200	37,800	57,00
Sierra	1,087	219	13	10,682	22,637	91,000	131,00
Socorro	65,119	12,549	121	65,584	243,300	3,197,782	8,948,00
	7,850,208	346,165	4,031	389,059	¹ 137,170,486	13,003,780	101,392,99
Total, 1943	8,231,359	360,796	3,581	376,853	² 149,476,321	11,143,411	119,026,00

BY CLASSES OF ORE CONCENTRATED

Copper.....	7,120,423	224,475	1,767	52,149	¹ 135,462,519	20,311	-----
Lead.....	110	11	1	143	100	10,976	-----
Zinc.....	8,257	1,353	-----	1,111	8,802	15,942	1,488,553
Zinc-lead.....	723,418	120,326	2,263	335,656	1,699,065	12,956,551	99,904,441
	7,850,208	346,165	4,031	389,059	¹ 137,170,486	13,003,780	101,392,994

¹ Includes 23,936,645 pounds of copper recovered from precipitates from mine water and leached dumps.

² Includes 27,744,537 pounds of copper recovered from precipitates from mine water and leached dumps.

Gross metal content of New Mexico crude ore shipped to smelters in 1944, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold.....	182	395	264	1,474	2,951	-----
Dry and siliceous gold-silver.....	1,866	1,071	61,527	1,316	-----	-----
Dry and siliceous silver.....	217	-----	1,024	7,425	14,905	-----
Copper.....	87,131	776	63,112	2,294,771	287,636	-----
Lead.....	4,167	635	20,136	62,628	1,502,539	-----
Total to copper and lead plants.....	93,563	2,877	146,083	2,367,614	1,808,031	-----
Zinc.....	75	3	220	1,480	2,956	77,111
Total to zinc plants.....	75	3	220	1,480	2,956	77,111
	93,638	2,880	146,303	2,369,094	1,810,987	77,111
Total, 1943.....	97,544	1,828	86,684	2,943,346	427,315	27,897

Mine production of metals from New Mexico crude ore shipped to smelters in 1944, by counties, in terms of recovered metals

County	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Catron.....	1,862	1,069	61,349	1,000	-----	-----
Dona Ana.....	12	-----	180	400	1,200	-----
Grant.....	71,134	508	5,405	1,146,219	750,796	18,006
Guadalupe.....	8,864	-----	308	595,000	-----	-----
Hidalgo.....	9,198	765	65,759	482,432	304,006	-----
San Miguel.....	2,185	528	11,593	55,400	418,000	43,000
Sierra.....	171	2	1,125	7,363	10,000	-----
Socorro.....	212	7	497	1,700	42,218	-----
	93,638	2,879	146,216	2,289,514	1,526,220	61,006
Total, 1943.....	97,544	1,828	86,684	2,849,679	302,589	22,000

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1944, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Cañon County: Mogollon.....	1	2	1,862	1,069	3	1,069	61,349	---	61,349	1,000	---	---	\$81,176
Colfax County: Mount Baldy.....	2	---	12	---	---	---	180	---	180	400	1,200	---	108,278
Dona Ana County: Organ	2	---	---	---	---	---	---	---	---	---	---	---	---
Grant County:	2	---	833	2	---	2	1,329	---	1,329	1,321,000	23,500	58,600	349,910
Burro Mountain.....	17	---	7,699,890	2,327	---	2,327	216,554	---	216,554	1,131,040,400	8,857,000	89,296,000	28,814,197
Central.....	2	---	290	---	---	---	2,385	---	2,385	---	31,700	26,000	7,163
Eureka.....	4	---	7,649	221	---	221	18,585	---	18,585	26,200	304,300	1,015,400	164,588
Pinos Altos.....	2	---	15,460	295	---	295	21,181	---	21,181	210,800	838,500	944,000	228,541
Sageble Rock.....	2	---	6,820	5	---	5	8,273	---	8,273	15,000	328,000	868,000	132,135
Swartz.....	2	---	8,864	---	---	---	308	---	308	595,000	---	---	80,544
Guadalupe County:	1	---	---	---	---	---	---	---	---	---	---	---	---
Hidalgo County:	1	---	231	1	---	1	1,236	---	1,236	400	40,600	---	4,936
Apache.....	7	---	132,707	2,316	---	2,316	113,739	---	113,739	4,717,400	292,800	78,000	831,106
Lordsburg.....	1	---	37	---	---	---	76	---	76	200	6,600	---	609
San Simon.....	1	---	2,185	528	---	528	11,563	---	11,563	55,400	418,000	43,000	72,545
San Miguel County: Willow Creek (Terrero).....	1	---	447	3	---	3	599	---	599	1,200	37,800	57,000	10,215
Santa Fe County: Cerrillos.....	2	---	---	---	---	---	---	---	---	---	---	---	---
Sierra County:	2	---	162	2	---	2	1,125	---	1,125	6,200	10,000	131,000	2,507
Chloride.....	2	---	1,096	13	---	13	10,682	---	10,682	23,800	91,000	---	33,478
Kingston.....	2	---	---	5	---	5	---	---	---	---	---	---	175
Las Animas (Hillsboro).....	1	---	65,331	128	---	128	66,081	---	66,081	245,000	3,240,000	8,948,000	1,363,818
Socorro County: Magdalena.....	6	---	---	---	---	---	---	---	---	---	---	---	---
Total New Mexico.....	55	3	7,943,846	6,910	8	6,918	535,275	---	535,275	1,139,460,000	14,530,000	101,454,000	32,178,026

¹ Includes copper recovered from precipitates.

CATRON COUNTY

Mogollon district.—The Silver Creek Mining Co. operated the Eureka mine throughout 1944 and shipped 1,862 tons of dry gold-silver ore containing 1,069 ounces of gold, 61,349 ounces of silver, and 1,129 pounds of copper to the El Paso smelter.

DONA ANA COUNTY

Organ district.—The Hornspoon and Nellie Bly mines were operated during the latter part of 1944 by the B-3-M Corp.; 12 tons of ore containing 180 ounces of silver, 414 pounds of copper, and 1,324 pounds of lead were shipped to El Paso for smelting.

GRANT COUNTY

Burro Mountain (Tyrone) district.—Throughout 1944 the Phelps Dodge Corp. continued leaching operations at its Burro Mountain mine. Water is percolated through the subsided areas of the former mine workings, and copper is precipitated from the return solutions. The copper content of the leach water and the production of precipitates continued to decline in 1944. L. Yacomo and Marvin Fuller continued production from the Contact group of claims until April 1, 1944; 833 tons of zinc-lead sulfide ore were shipped to the Hanover Unit custom mill.

Central district (Bayard, Fierro, Georgetown, Hanover, Santa Rita).—The Chino Mines Division of the Kennecott Copper Corp., largest copper producer in New Mexico, operated its open-pit mine at Santa Rita and its flotation mill and reverberatory copper smelter at Hurley at approximate capacity throughout 1944. The manpower shortage became so critical during the latter part of the year that on October 16 the company was forced to reduce operations to a 6-day week. Copper continued to be recovered by leaching accumulated dump material from the pit and from siliceous copper ore used in the converters as a flux. Molybdenum, gold, and silver are recovered in the concentration mill as byproducts. Most of the copper produced in 1944 was marketed in the form of fire-refined copper bars. The company continued development of its Oswaldo and Ivanhoe zinc properties in the Central district. Zinc-lead ore from the Oswaldo property was treated in the Empire Zinc Co. mill at Hanover.

Despite a 14-percent decrease in production of recovered zinc compared with 1943, the Central district continued to be the fourth-largest zinc-producing district in the United States. The largest producer of zinc in the Central district in 1944 was the Bullfrog mine and 450-ton selective-flotation mill of the United States Smelting, Refining & Mining Co., which operated continuously during the year. Lead concentrates produced were shipped to the El Paso smelter; zinc concentrates were shipped to the Dumas (Tex.), Fort Smith (Ark.), and Great Falls (Mont.) reduction plants. Development at the Bullfrog property included 4,284 feet of drifts, 733 feet of raises, 19,563 feet of diamond drilling, and 455 feet of shaft sinking. The company conducted an intensive drilling program in the district on the many claims it owns or holds under option; 13 core-drilling machines were in operation during the year. The Peru Mining Co. continued to operate its Pewabic, Copper Flat, and Kearny mines.

from the mines is treated at the company 1,000-ton selective-flotation mill at Wemple near Deming (Luna County).

The Empire Zinc Co. operated its Hanover mine group and selective-flotation mill continuously in 1944. In addition to ore from the company properties in the Central district, the mill treated ore from the company Lynchburg and Kelly mines at Kelly, Socorro County, and the Oswaldo mine of the Kennecott Copper Corp. in the Central district.

The American Smelting & Refining Co. continued to operate its Ground Hog Unit (Ground Hog, Lucky Bill, and San Jose claims) and released Hanover milling unit (formerly Combination-Black Hawk) throughout 1944. Crude lead ore shipped to the El Paso smelter was produced from the Denver claim. Development at the Ground Hog mine included 8,939 feet of drifts and 36,088 feet of diamond drilling. The mine is developed by a three-compartment vertical shaft to the 600-foot level and then an inclined winze extending to the 1,000-foot level. The Hanover milling unit operated at capacity (400 tons per day) throughout the year. In addition to company ore from the Ground Hog mine, the mill treated custom ore (comprising 5 percent of the total mill feed) from the Hobo, Barringer (September), Peerless, and Three Brothers mines in the Central district; the Columbus, Grandview, Royal John, and Patsy mines in the Swartz (Carpenter) district; the Cleveland and Houston-Thomas properties in the Pinos Altos district; the Contact mine in the Burro Mountain (Tyrone) district; the Hornet mine in the Eureka district; the Ruth mine near Lordsburg; the Percha mine near Kingston; the Nitt and Blue Stone properties at Kelly; and the Tom Payne mine near Cerrillos.

The Black Hawk Consolidated Mines Co., largest custom ore shipper to the Hanover milling unit, operated its Hobo mine throughout the year; 41,190 tons of zinc-lead sulfide ore were milled. Important developments at this property in 1944 were the sinking of the Hobo shaft from 300 feet to 400 feet and the opening of Hobo shaft No. 2 to the 100-foot level; 947 feet of drifts also were completed. The New Mexico Ore Processing Co. continued to operate its Peerless mine in the Central district and did development on several claims in the Pinos Altos district. Zinc-lead sulfide ore from the company properties was treated in the Continental 100-ton selective-flotation mill at Silver City (purchased from the Continental Chemical & Ore Co. in March 1944). Several shipments of ore were made to the El Paso smelter from the Little Goat, Boston Bicket, and Mike mines.

Eureka district.—The Mineral Production Co. operated the Hornet property intermittently during 1944; 218 tons of zinc-lead ore containing 2,283 ounces of silver, 829 pounds of copper, 26,226 pounds of lead, and 33,515 pounds of zinc were shipped to the Hanover Unit custom mill. M. J. Fowles shipped 1 car of lead ore to the El Paso smelter from the American claim.

Pinos Altos district.—R. R. Foster, W. R. Jenks, and Douglas White, lessees, operated the Cleveland mine throughout 1944 and made regular shipments of zinc-lead ore to the Hanover Unit custom mill. B. O. Shepherd shipped zinc-lead ore to the Hanover mill from his Houston-Thomas mine. Lead ore was shipped to the El Paso smelter from the Cleveland, Houston-Thomas, and Hardluck properties.

Steeple Rock district.—The Exploration Syndicate, Inc., continued to lease and operate the Carlisle group of mines. Before conversion of the East Camp cyanide mill to selective flotation (completed in September) the Carlisle ore was treated at the Southwestern Minerals Co. mill at Duncan, Ariz. In addition to conversion of the East Camp mill, the company completed 650 feet of drifts and 7,000 feet of exploratory diamond drilling in 1944. In November, Carl Elayer and K. C. Richmond leased the Center claim; 46 tons of dry gold ore containing 22 ounces of gold, 113 ounces of silver, 1,371 pounds of copper, and 457 pounds of lead were shipped to the El Paso smelter.

Schwartz (Carpenter, Camp Monarch) district.—The Black Range Development Co. operated the Columbia, Grandview, and Patsy mines throughout the year; 4,496 tons of zinc-lead ore were shipped to the Hanover Unit custom mill. Zinc-lead ore totaling 2,324 tons was shipped also to the Hanover mill from the Royal John mine, operated by A. L. Owen.

GUADALUPE COUNTY

The Guadalupe Mining Co. continued to operate the Stauber mine near Pastura. Siliceous copper ore totaling 8,864 tons and containing 308 ounces of silver and 619,675 pounds of copper was shipped to the El Paso smelter.

HIDALGO COUNTY

Apache district.—E. J. Marston operated the Monarch and Copper Crown claims during the first half of 1944; 231 tons of lead ore shipped to the El Paso smelter contained 1 ounce of gold, 1,236 ounces of silver, 597 pounds of copper, and 55,171 pounds of lead.

Lordsburg district.—The Banner Mining Co. operated its Bonney mine and 500-ton flotation mill 6 miles south of Lordsburg continuously throughout 1944 on ore from the Lone and Shoofly claims. The company proceeded with development of the lower levels of the mine and sank the main shaft an additional 25 feet, giving it a total depth of slightly over 1,500 feet. The mill treated an average of 336 tons of ore per day; copper concentrates produced were shipped to the El Paso smelter. The Atwood group of claims on Atwood Hill near Valedon, 4 miles south of Lordsburg, was operated throughout the year by C. H. McIntosh. Shipments of siliceous copper ore to the El Paso smelter totaled 6,410 tons containing 641 ounces of gold, 57,811 ounces of silver, 354,897 pounds of copper, and 276,916 pounds of lead. Siliceous copper ore was shipped to the Miami (Ariz.) smelter from the Miser's Chest mine operated by Charles J. Hutchinson. The National Zinc Corp. made several shipments of zinc-lead sulfide ore from the Ruth mine to the Hanover Unit custom mill (Grant County). Other producing properties in the Lordsburg district were the Waldo, Tom group, and Anita mines.

San Simon (Steins) district.—J. H. Byrd worked the Crosby mine; 37 tons of lead ore containing 76 ounces of silver, 223 pounds of copper, and 7,374 pounds of lead were shipped to the El Paso smelter.

LUNA COUNTY

Deming district.—The Peru Mining Co. 1,000-ton selective-flotation mill at Wemple near Deming operated continuously during 1944 on

from the company Pewabic, Copper Flat, and Kearny mines near Silver (Grant County).

SAN MIGUEL COUNTY

Elbow Creek district (Terrero).—The Pecos mine, operated by the Pecos Mining Co. throughout 1944, produced copper, lead, and zinc which were shipped to smelters in Texas and Oklahoma.

SANTA FE COUNTY

Cerrillos district.—A. B. Stewart shipped 337 tons of zinc-lead sulfide ore from the Tom Payne mine, 8 miles north of Cerrillos, to the Hanover Unit custom mill during 1944. The Franklin Mines, Inc., and the Franklyn and Cash Entry mines north of Cerrillos from May 1 to June 1. A 25-ton experimental plant recovered 11 tons of lead concentrates containing 1 ounce of gold, 143 ounces of silver, 2 pounds of copper, and 12,196 pounds of lead. Considerable development and exploration of mining properties in the Cerrillos district were reported during the year.

SIERRA COUNTY

Chloride (Apache, Cuchillo Negro) district.—An operator on the Far Baby mine shipped 158 tons of dry silver ore to the El Paso smelter.

Kingston district.—The Percha mine on South Percha Creek west of Kingston was operated throughout 1944. Zinc-lead sulfide ore, totaling 1,087 tons and containing 28 ounces of gold, 14,341 ounces of silver, 36,916 pounds of copper, 120,817 pounds of lead, and 176,232 pounds of zinc, was shipped to the Hanover Unit custom mill (Grant County). A small lot of copper ore was shipped from the Copper King mine to the El Paso smelter.

• SOCORRO COUNTY

Magdalena district.—The American Smelting & Refining Co. continued to operate the Magdalena Unit (Waldo mine) and 200-ton selective-flotation mill during 1944. A shortage of mine labor and consequent reduction in ore output permitted the mill to operate only 6 days per week. Development completed during the year included 1,540 feet of drifts, 153 feet of winze, and 12,449 feet of diamond drilling. Concentrates produced were shipped to the Dumas (Tex.) smelter of the American Zinc Co. of Illinois and the El Paso smelter. Kenneth Hughes and J. D. Torres worked the Kelly Unit (Lynchburg and Kelly mines) under lease throughout the year and shipped zinc-lead ore to the Empire Zinc Co. selective-flotation mill at Hanover (Grant County). J. A. McDonald made regular shipments of zinc-lead ore from the Nitt claim to the Hanover Unit custom mill, to which also several cars of zinc-lead ore were shipped from the Blue Stone mine. Limited operations were carried on at the East Star and La Plata mines; several shipments of lead ore were made to the El Paso smelter.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN OREGON

(MINE REPORT)

By CHARLES WHITE MERRILL

SUMMARY OUTLINE

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SUMMARY

Gold production in Oregon in 1944, although 25 percent above the 1943 output, was less than 2 percent of the all-time record set just 4 years earlier (in 1940). Silver production nearly doubled in 1944 compared with 1943 but was otherwise the lowest since 1932. Copper output was the lowest since 1931; and lead production, which was very low, remained unchanged from 1943. No recovery of zinc has been reported since 1937.

The total value of the gold, silver, copper, and lead (in terms of recovered metals) produced in Oregon was \$63,760 in 1944, compared with \$48,038 in 1943 and with \$4,148,271 in the peak year 1940. It was divided among the metals as follows: Gold, 75 percent; silver, 23 percent; and copper and lead, 1 percent each. Jefferson County displaced Baker County in 1944 in total value of metal output, but the value of Baker County production was nearly as much.

Rising wages, enlistment of miners in the armed forces, migration of miners to war industries, rising costs of supplies and equipment and the difficulties of obtaining them, higher taxes, and a fixed price for gold and silver (principal metals produced in the State) were factors that continued to hold the mining industry near the low level that prevailed during 1943. Production, which had sunk to approximately one-third that in 1940, quickly collapsed when the War Production Board issued Order L-208 on October 8, 1942. All the larger gold, silver, copper, lead, and zinc mines had suspended operations before December 31, 1942, and none resumed work during 1943 or 1944.

Lode mines contributed 79 percent and placers 21 percent of the gold produced in Oregon in 1944. For a number of years before 1942, lode mines had produced about one-third and placers two-thirds of the gold output.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Barrelage figures used in measuring material treated in placer operations are bank measure; that is, the material is measured in the barrel before treatment.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ³	Zinc ³
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940	\$35.00	\$40.711+	\$0.113	\$0.050	\$0.063
1941	35.00	4.711+	.118	.057	.075
1942	35.00	4.711+	.121	.067	.093
1943	35.00	4.711+	.130	.075	.108
1944	35.00	4.711+	.135	.080	.114

¹ Under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 31, 1937, to Jan. 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-44: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price of bonds payments by Metals Reserve Co. for overquota production.

⁴ Barrels.

Metal production of gold, silver, copper, lead, and zinc in Oregon, 1940-44, and total, 1852-1944, in terms of recovered metals

Year	Mines producing ¹		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1940	112	192	105,469	113,402	\$3,969,070	219,112	\$155,813
1941	91	153	98,160	96,565	3,379,775	276,158	196,379
1942	48	83	31,728	46,233	1,618,155	87,376	62,134
1943	16	16	2,680	1,097	38,395	10,523	7,483
1944	13	10	4,217	1,369	47,915	20,243	14,395
1852-1944			(²)	5,669,487	126,395,088	5,207,924	4,781,399

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1940	176,000	\$19,888	70,000	\$3,500			\$4,148,271
1941	166,000	19,588	118,000	6,726			3,602,468
1942	206,000	24,926	46,000	3,082			1,708,297
1943	12,000	1,560	8,000	600			48,038
1944	6,000	810	8,000	640			63,760
1852-1944	12,335	4,638,025	745	76,173	140	\$13,846	135,904,531

¹ Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

² Figures not available.

³ Short tons.

Gold produced at placer mines in Oregon, 1940-44, by classes of mines and by method of recovery

Class and method	Mines producing ¹	Material treated (cubic yards)	Gold recovered		
			Fine ounces	Value	Average per cubic yard
Surface placers:					
Gravel mechanically handled:					
Connected-bucket dredges:					
1940.....	6	7,580,000	24,951	\$873,285	\$0.11
1941.....	7	6,670,000	24,131	844,585	.11
1942.....	6	4,725,000	21,641	757,435	.10
1943-44.....					
Dragline: ²					
1940.....	23	7,361,000	35,216	1,232,560	.16
1941.....	25	6,256,000	28,395	993,825	.15
1942.....	14	2,852,000	13,383	468,405	.16
1943.....	(3)		5	175	
1944.....					
Suction dredges: ⁴					
1941.....	1	27,000	191	6,685	.24
1942-44.....					
Nonfloating washing plants: ⁵					
1940.....	29	638,000	4,092	143,220	.224
1941.....	17	567,000	2,757	96,495	.170
1942.....	6	45,000	380	13,300	.296
1943.....	(3)		17	595	
1944.....	(3)		71	2,485	
Gravel hydraulically handled:					
Hydraulic:					
1940.....	82	599,000	2,731	95,585	.160
1941.....	63	683,000	2,306	80,710	.118
1942.....	41	306,000	1,420	49,700	.162
1943.....	10	38,000	124	4,340	.114
1944.....	4	22,700	99	3,465	.153
Small-scale hand methods: ⁶					
Wet:					
1940.....	44	499,300	4,279	149,765	.300
1941.....	33	438,300	2,553	89,355	.204
1942.....	12	220,500	1,462	51,170	.232
1943.....	4	2,750	52	1,820	.662
1944.....	6	7,500	123	4,305	.574
Dry:					
1940.....	1	500	21	735	1.470
1941.....	1	100	3	105	1.050
1942-44.....					
Underground placers:					
Drift:					
1940.....	10	6,200	287	10,045	1.620
1941.....	6	4,600	94	3,290	.715
1942.....	4	1,500	50	1,750	1.167
1943.....	2	250	10	350	1.400
1944.....					
Grand total placer:					
1940.....	192	16,684,000	71,577	2,505,195	.150
1941.....	153	14,646,000	60,430	2,115,050	.144
1942.....	83	8,150,000	38,336	1,341,700	.165
1943.....	16	41,000	208	7,280	.178
1944.....	10	30,200	293	10,255	.340

¹ Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

² Includes all placer operations using dragline excavator for delivering gravel to floating washing plant.

³ Gold from terminal clean-up; property and equipment not counted as producing.

⁴ Includes all placer operations using suction pump for delivering gravel to floating washing plant, except those producing less than 100 ounces of gold, which are included under "Small-scale hand methods"; no suction dredges reported for 1940.

⁵ Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."

⁶ Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, etc.

⁷ A mine using more than 1 method of recovery is counted but once in arriving at total for all methods.

Gold.—The level of gold production in Oregon in 1943 and 1944 was lowest since 1902 and was probably the lowest since the years ending the discovery period in the 1850's. Placer mining was varied more than lode mining. Hydraulic, small-scale hand methods, and terminal clean-ups at idle plants where gravel had been mined mechanically accounted for the placer gold output in 1944. The lode gold came from siliceous ores, and most of this ore was mined chiefly for gold. There were 23 Oregon properties producing in 1944—13 lode mines and 10 placers; none produced as much as \$8,000 worth of gold.

Silver.—Silver production in Oregon in 1944 nearly doubled compared with 1943. Jefferson County yielded over 80 percent of the state total. Dry gold-silver ore was the principal source of silver and the direct smelting of ore the principal method of recovery.

Copper, lead, and zinc.—Copper production sank to 6,000 pounds, the lowest since 1931; lead output was 8,000 pounds, the same as in 1943 but otherwise the lowest since 1932. No zinc was reported recovered.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, and lead in Oregon in 1944, by counties, in terms of recovered metals

County	Mines producing ¹		Gold					
	Lode	Placer	Lode		Placer		Total	
			Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Clatsop	5	(?)	468	\$16,380	27	\$945	495	\$17,325
Jefferson	1		223	7,805			223	7,805
Lincoln		1			2	70	2	70
Malheur	1	1	110	3,850	17	595	127	4,445
Wasco, Lake, and Union	3	2	117	4,095	48	1,680	165	5,775
Wheeler	3		158	5,530			158	5,530
Yamhill		5			198	6,930	198	6,930
Total, 1944	13	10	1,076	37,660	293	10,255	1,369	47,915
	16	16	889	31,115	208	7,280	1,097	38,395

County	Silver (lode and placer) ²		Copper		Lead		Total value
	Fine ounces	Value	Pounds	Value	Pounds	Value	
Jefferson	1,506	\$1,071					\$18,396
Malheur	38	27					7,832
Wasco							70
Union	900	640					5,085
Lincoln	41	29					5,804
Wasco, Lake, and Union	17,734	12,611	6,000	\$810	8,000	\$640	19,591
Wheeler	24	17					6,947
Total, 1944	20,243	14,395	6,000	810	8,000	640	63,700
	10,523	7,483	12,000	1,560	8,000	600	48,038

¹ Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

² Portion of property not classed as a "mine."

³ Combined to avoid disclosure of individual outputs.

⁴ Figures of total silver as follows—1944: 20,205 ounces from lode mines and 38 ounces from placers; 1943: 16,600 ounces from lode mines and 28 ounces from placers.

MINING INDUSTRY

Of the 4,217 tons of ore (including 1,000 tons of old tailings) sold or treated in Oregon in 1944, Baker County produced 2,488 tons or 59 percent and Jefferson County 1,561 tons or 37 percent. Over 6 percent of the total (including all the old tailings) was dry gold ore, and almost all the remainder was dry gold-silver ore.

No connected-bucket dredge, dragline dredge, or nonfloating washing plant, to which gravel was delivered by mechanical means was in production in 1944. However, final clean-ups at suspended operations resulted in the recovery of some gold, which is credited to nonfloating washing plants. The only consumption of quicksilver reported for Oregon placer mines in 1944 was at hydraulic operations, where 3 pounds were consumed, or 1 pound of quicksilver for each 33 ounces of gold recovered in 1944 compared with 1 pound of quicksilver for each 4 ounces of gold recovered at hydraulic operations in 1943.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore and old tailings sold or treated in Oregon in 1944, with content in terms of recovered metals

Source	Material sold or treated		Gold	Silver	Copper	Lead
	Ore	Old tailings				
	<i>Short tons</i>	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>
Dry and siliceous gold ore.....	1,628	1,000	926	2,475		
Dry and siliceous gold-silver ore.....	1,561		150	16,754	6,000	8,000
Dry and siliceous silver ore.....	28			976		
Total, lode mines.....	3,217	1,000	1,076	20,205	6,000	8,000
Total, placers.....			293	38		
	3,217	1,000	1,369	20,243	6,000	8,000
Total, 1943.....	2,643	37	1,097	10,523	12,000	8,000

METALLURGIC INDUSTRY

Of the State total ore and old tailings (4,217 tons), 42 percent was shipped crude to smelters; 26 percent (including all the old tailings) was cyanided; 22 percent was concentrated and the concentrates smelted; and 10 percent was amalgamated. Ultimate recovery of 65 percent of the total lode gold was from the smelting of ore, 20 percent was as bullion from the cyanidation of ore, 12 percent was as bullion from the amalgamation of ore, and 3 percent was recovered by the smelting of flotation concentrates. Nearly three-fourths of the silver was recovered by the direct smelting of ore and most of the remainder by the smelting of flotation concentrates. All material requiring smelting was shipped out of the State, as Oregon has no smelters. No data are available covering quicksilver or cyanide consumption at Oregon mills in 1944.

Production of metals in Oregon in 1944, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead
	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>
.....	425	129	47	.....	.....
.....	1,084	209	851	.....	.....
.....	91	37	4,459	2,000	3,000
.....	1,783	701	14,848	4,000	5,000
.....	.....	1,076	20,205	6,000	8,000
.....	.....	293	38	.....	.....
.....	.....	1,369	20,243	6,000	8,000
.....	.....	1,097	10,523	12,000	8,000

Production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Oregon in 1944, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal		
	Ore	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver
	<i>Short tons</i>	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>
.....	424	.....	46	33	.....	.....	.....
.....	1	.....	83	14	.....	.....	.....
.....	425	.....	129	47	.....	.....	.....
.....	111	.....	273	91	.....	.....	.....

CYANIDATION MILLS

.....	84	1,000	145	840	.....	.....	.....
.....	84	1,000	64	11	.....	.....	.....
.....	84	.....	209	851	.....	.....	.....
.....	90	.....	43	10	.....	.....	.....
.....	509	1,000	338	898	.....	.....	.....
.....	201	.....	316	101	.....	.....	.....

Production of metals from concentrating mills in Oregon in 1944, by counties, in terms of recovered metals

County	Material treated		Concentrates smelted and recovered metal				
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead
	<i>Short tons</i>	<i>Short tons</i>	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>
.....	925	.....	91	37	4,459	2,000	3,000
.....	925	.....	91	37	4,459	2,000	3,000
.....	1,650	.....	200	155	8,776	5,000	7,300

Continued to avoid disclosure of individual outputs.

Gross metal content of concentrates produced from ores mined in Oregon in 1944, by classes of concentrates

Class of concentrates	Concentrates	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
		<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
.....	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
.....	1	10	.....	.....	90	.....
.....	90	36	4,449	2,198	5,964	.....
.....	91	37	4,459	2,198	6,054	.....
.....	200	155	8,776	5,363	10,120	.....

*Mine production of metals from Oregon concentrates shipped to smelter in 1944,
in terms of recovered metals*

BY COUNTIES

	Concen- trates	Gold	Silver	Copper	Lead
	Short tons	Fine ounces	Fine ounces	Pounds	Pounds
Jackson and Jefferson ¹	91	37	4,459	2,000	3,000
Total, 1943.....	91	37	4,459	2,000	3,000
	200	155	8,776	5,000	7,300

BY CLASSES OF CONCENTRATES

	1	1	10		
Dry gold.....	90	36	4,449	2,000	3,000
Dry gold-silver.....	91	37	4,459	2,000	3,000

¹ Combined to avoid disclosure of individual outputs.

*Gross metal content of Oregon crude ore and old tailings shipped to smelters in 1944
by classes of material*

Class of material	Material shipped		Gross metal content			
	Ore	Old tailings	Gold	Silver	Copper	Lead
	Short tons	Short tons	Fine ounces	Fine ounces	Pounds	Pounds
Dry and siliceous gold.....	1,094	587	1,567	666	446	
Dry and siliceous gold-silver.....	661	114	12,305	4,193	9,417	
Dry and siliceous silver.....	28	976		144	1,330	
Total, 1943.....	1,783	701	14,848	5,003	11,193	
	792	37	418	1,618	7,322	1,221

*Mine production of metals from Oregon crude ore and old tailings shipped to smelters
in 1944, in terms of recovered metals*

BY COUNTIES

	Material shipped		Gold	Silver	Copper	Lead
	Ore	Old tailings				
	Short tons	Short tons	Fine ounces	Fine ounces	Pounds	Pounds
Baker.....	1,064	277	629			
Curry.....	1	159	27			
Grant.....	23	110	900			
Jackson and Jefferson ¹	665	147	12,312	4,000	5,000	
Lake.....	2	8	4			
Union.....	28	976				
Total, 1943.....	1,783	701	14,848	4,000	5,000	
	792	37	418	1,618	7,000	700

BY CLASSES OF MATERIAL

	1,094	587	1,567			
Dry and siliceous gold.....	661	114	12,305	4,000	5,000	
Dry and siliceous gold-silver.....	28	976				
Dry and siliceous silver.....	1,783	701	14,848	4,000	5,000	

¹ Combined to avoid disclosure of individual outputs.

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, and lead in Oregon in 1944, by counties and districts, in terms of recovered materials.

County and district	Mines producing		Ore and old tailings	Gold			Silver (ounce and place)	Copper	Lead	Total value
	Lode	Placer		Lode	Placer	Total				
Baker County:										
Baker		(1)	Short tons	Fine ounces	Fine ounces	Fine ounces	Fine ounces	Pounds	Pounds	\$492
Cracker Creek	2		1,574	236	14	250	1,419			9,260
Sumpter		(1)			13	13				456
Virtue	2		890	213		213	76			7,509
Weatherby	1		15	19		19	7			670
Curry County: Chetoo	1		85	223	2	225	38			7,832
Douglas County: Riddle		1								70
Grant County:										
Canyon		1			17	17				585
Granite	1		23	110		110	900			4,490
Jackson County:										
Elk Creek	1		25	1		1	10			42
Greenback	1		4	33		33	7			1,160
Gold Hill	1		1	83		83	18			3,723
Upper Applegate		1			25	25	6			879
Josephine County:										
Althouse										
Galice		(1)			5	5	1			176
Grants Pass					86	86	9			3,016
Greenback		(1)			5	5				175
Illinois River		3			84	84	13			2,949
Waldo		1			12	12	1			421
Umatilla County: North Fork		1			6	6				210
Combined counties and districts	3		1,591	158	1	159	17,734	6,000	8,000	19,591
Total Oregon	13	10	4,217	1,076	293	1,369	20,243	6,000	8,000	63,790

¹ Only those counties and districts shown separately for which Bureau of Mines is at liberty to publish figures; others producing listed in footnote 6 and their output included under "Combined counties and districts."

² Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

³ Source of total silver as follows: 20,205 ounces from lode mines, 38 ounces from placers.

⁴ Output from a property not classed as a "mine."

⁵ Greenback district lies in both Jackson and Josephine Counties.

⁶ Includes following districts: Ashwood in Jefferson County; New Pine Creek in Lake County; and Grande Ronde in Union County.

BAKER COUNTY

Cracker Creek district.—Bald Mountain Mine operated the Bald Mountain mine throughout 1944; part of the gold ore produced was treated by amalgamation, and part was shipped to a smelter. Lessee worked the Columbia mine during 1944; 57 tons of ore containing 3 ounces of gold and 117 ounces of silver were shipped to a smelter, and 1,000 tons of old tailings cyanided yielded 145 ounces of gold and 84 ounces of silver.

Virtue district.—Anthony Brandenthaler shipped 898 tons of antimony ore from the Gray Eagle mine; the ore contained 212 ounces of gold, 76 ounces of silver, and 382 pounds of copper, in addition to antimony.

Weatherby district.—A. V. Lovejoy recovered 19 ounces of gold and 7 ounces of silver from 15 tons of ore produced at the Gleason mine.

CURRY COUNTY

Chetco district.—W. D. Bowser operated the Robert E. mine throughout 1944; 84 tons of ore cyanided yielded 64 ounces of gold and 11 ounces of silver, and 1 ton of ore shipped to a smelter contained 159 ounces of gold and 27 ounces of silver.

GRANT COUNTY

Granite district.—Bruce Dennis shipped from the Buffalo mine 23 tons of ore containing 110 ounces of gold, 900 ounces of silver, 152 pounds of copper, and 444 pounds of lead.

JACKSON COUNTY

Gold Hill district.—Lance Bros. hydraulicked 1,200 cubic yards of gravel at the Lance mine on Footh Creek and recovered 16 ounces of gold and 3 ounces of silver. Mardon Bros., largest gold producer in the State in 1943, amalgamated 1 ton of ore in 1944 from the Sunrise mine, from which 83 ounces of gold and 14 ounces of silver were recovered.

Upper Applegate district.—George Lewis hydraulicked 1,500 cubic yards of gravel at the Sterling mine and recovered 15 ounces of gold and 2 ounces of silver.

JEFFERSON COUNTY

Ashwood district.—The Oregon King mine was operated by E. Rohlfing until May 15, 1944, when the property was taken over by Henry Anderegg, who continued work until the end of the year. Gold-silver ore was treated in the company 50-ton flotation mill, and gold-silver concentrates were shipped to a smelter. In addition, gold-silver ore was shipped for direct smelting.

JOSEPHINE COUNTY

Seaback district.—M. H. Davis carried on a hydraulicking operation at the Blue Channel mine on Coyote Creek in 1944 from January to May 1.

UNION COUNTY

Pan de Ronde district.—The Union Silver Mining Co. shipped 28 tons of silver ore containing 976 ounces of silver, 144 pounds of copper, and 1,330 pounds of lead from the Indiana mine while carrying on development.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN SOUTH DAKOTA

(MINE REPORT)

By RICHARD H. MOTE

SUMMARY OUTLINE

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SUMMARY

South Dakota gold production in 1944 fell below that in any year since 1875—the year gold was discovered in the gravels of French Creek near the present site of Custer. Silver production was the lowest since 1876. Most of the gold produced during 1944 came from a thorough clean-up of equipment in connection with regular maintenance at the Homestake mill. The output of recovered gold in the State was 11,621 fine ounces valued at \$406,735, compared with 106,444 ounces valued at \$3,725,540 in 1943; in addition to gold, South Dakota in 1944 produced 5,445 fine ounces of silver, 2,000 pounds of recovered copper, 68,000 pounds of recovered lead, and 112,000 pounds of recovered zinc. No placer gold was produced in 1944.

All tonnage figures are short tons and “dry weight”; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ³	Zinc ³
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940	\$35.00	\$0.711+	\$0.113	\$0.050	\$0.063
1941	35.00	¢.711+	.118	.057	.075
1942	35.00	¢.711+	.121	.067	.093
1943	35.00	¢.711+	.130	.075	.108
1944	35.00	¢.711+	.135	.080	.114

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price includes bonus payments by Metals Reserve Co. for overquota production.

¢ \$0.71111111.

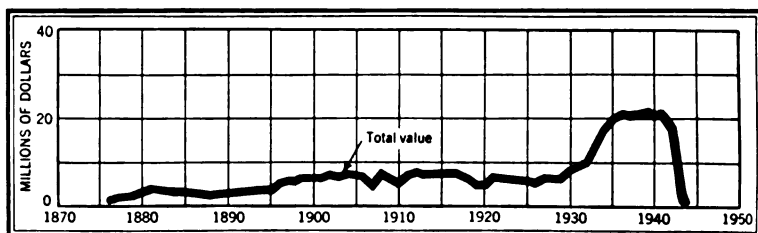


FIGURE 1.—Total value of mine production of gold and silver in South Dakota, 1876-1944.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN SOUTH DAKOTA 431

Production of gold, silver, copper, lead, and zinc in South Dakota, 1940-44, and total, 1876-1944, in terms of recovered metals ¹

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1876-1944	11	81	1,667,370	586,662	\$20,533,170	175,514	\$124,810
1940	10	41	1,711,744	600,637	21,022,295	170,771	121,437
1941	5	13	1,464,384	522,098	18,273,430	186,937	132,933
1942	3	-----	204,932	106,444	3,725,540	35,886	25,519
1943	2	-----	2,839	11,621	406,735	5,445	3,872
1944	-----	-----	(²)	20,678,106	505,330,919	9,574,544	6,810,952

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1876-1944	12,000	\$1,356	14,000	\$700	-----	-----	\$20,660,036
1940	-----	-----	-----	-----	-----	-----	21,143,732
1941	2,000	242	170,000	11,390	230,000	\$21,390	18,439,385
1942	-----	-----	82,000	6,150	92,000	9,936	3,767,145
1943	2,000	270	68,000	5,440	112,000	12,768	429,085
1944	106	36,466	1455	58,500	1217	44,064	512,280,931

¹ Total production of gold and silver in South Dakota, by years, see Mineral Resources, 1913, pt. 1, p. 42; Mineral Resources, 1922, pt. 1, p. 194; and subsequent volumes of Mineral Resources and Minerals Yearbook. ² Data not available. ³ Short tons.

Gold and silver produced at placer mines in South Dakota, 1940-44, in terms of recovered metals

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1940	229	\$8,015	21	\$15	\$8,030
1941	93	3,255	7	5	3,260
1942	33	1,155	3	2	1,157
1943	-----	-----	-----	-----	-----
1944	-----	-----	-----	-----	-----

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in South Dakota in 1944, by counties, in terms of recovered metals

County	Mines producing		Ore sold or treated (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
Lawrence	2	-----	2,839	11,621	\$406,735	5,445	\$3,872
Total, 1943	2	-----	2,839	11,621	406,735	5,445	3,872
	3	-----	204,932	106,444	3,725,540	35,886	25,519

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Lawrence	2,000	\$270	68,000	\$5,440	112,000	\$12,768	\$429,085
1940, 1943	2,000	270	68,000	5,440	112,000	12,768	429,085
	-----	-----	82,000	6,150	92,000	9,936	3,767,145

MINING AND METALLURGIC INDUSTRY

Ore mined and treated at lode mines in South Dakota in 1944 totaled 2,839 tons yielding, in terms of recovered metals, 126 fine ounces of gold, 2,777 fine ounces of silver, 2,000 pounds of copper, 68,000 pounds of lead, and 112,000 pounds of zinc. Maintenance during the year at the Homestake property included a clean-up of all mill equipment, which recovered 11,495 ounces of gold and 2,661 ounces of silver. No gold-bearing material was treated by amalgamation or cyanidation during 1944.

METALLURGIC RECOVERY

Gold and silver bullion produced at mills in South Dakota by amalgamation, 1940-44

Year	Ore treated	Gold in bullion	Silver in bullion	Quicksilver used
	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>
1940.....	1,479,905	313,964.15	60,254	4,997
1941.....	1,506,183	328,166.44	62,423	6,537
1942.....	1,275,138	276,298.00	56,852	3,561
1943.....	183,246	69,710.02	13,640	508
1944.....				

¹ Revised figures.

Gold and silver bullion produced at mills in South Dakota by cyanidation, 1940-44

Year	Material treated				Gold in bullion product	Silver in bullion product	Sodium cyanide used ¹
	Crude ore	Concentrates	Sands and slimes	Total			
	<i>Short tons</i>	<i>Short tons</i>	<i>Short tons</i>	<i>Short tons</i>	<i>Fine ounces</i>	<i>Fine ounces</i>	<i>Pounds</i>
1940.....	187,360		1,432,244	1,619,604	269,518.82	111,607	883,849
1941.....	205,356		1,499,000	1,704,356	270,989.89	106,437	903,680
1942.....	161,635	366	1,271,305	1,433,306	244,421.00	122,312	801,478
1943.....	18,772		178,318	197,090	36,679.00	19,048	149,326
1944.....							

¹ In terms of 96- to 98-percent strength.

² From 17,614 tons of crude ore treated by table and jig concentration.

³ Revised figures.

⁴ Includes 263,165 pounds of calcium cyanide (48- to 49-percent strength); all reduced to equivalent of 16- to 98-percent strength to conform with earlier use of figures for high-strength NaCN and KCN.

REVIEW BY COUNTIES

LAWRENCE COUNTY

Homestake mine.—Operations at the Homestake mine, owned and operated by the Homestake Mining Co. since 1877, consisted only of maintaining mine and mill property in adequate stand-by condition for immediate operation as soon as the gold-mine closing order is rescinded. During the course of maintenance all mill circuits and equipment were given a thorough cleaning, which recovered some gold bullion. No development was done by the company in 1944. The annual report of the general manager of the Homestake Mining Co. for the year ended December 31, 1944, says—

Operation of the mine was suspended during the entire year 1944 in accordance with Order L-208 of the War Production Board. This was the first full year since production began on July 12, 1878, in which no ore was mined nor milled.

launders, pipe lines, mill liners, and other machinery in the mills were thoroughly cleaned in the course of maintenance. Amalgam and precipitate recovered were treated and shipped. This accounts for the revenue amounting to \$2,591.29 from bullion during the year.

As there was neither production nor development during the year the reserve of shipped ore remains unchanged. It totals 19,005,835 tons, which includes 585 tons of broken ore in shrinkage stopes. * * *

Production of materials essential to the war effort continued in the machine shop and foundry with increasing output throughout the year. Volume of shipments was largest in the last 2 months of the year. * * *

The Homestake mine and plant have been maintained in excellent condition and are in readiness for operation.

Four hundred and sixty former employees have joined the armed forces.

Ore milled, receipts, and dividends, Homestake mine, 1940-44¹

Year	Ore milled (short tons)	Receipts for bullion product		Dividends
		Total	Per ton	
1940	1,433,737	\$19,014,767.73	\$13.2624	\$9,041,760
1941	1,499,988	19,529,080.70	13.0195	9,041,760
1942	1,276,138	17,068,437.84	13.3856	7,534,800
1943	183,246	3,628,507.33	19.8067	-----
1944	(²)	402,591.29	(²)	-----

¹ From 1936 to 1944, inclusive, this mine yielded bullion and concentrates that brought a net return of \$3,421,254 and paid \$149,805,802 in dividends.

² No ore milled; bullion product recovered in clean-up of launders, pipe lines, mill liners, and other machinery during course of mill maintenance.

Other mines.—The Belle Eldridge Gold Mines, Inc.—only metal mine operating in South Dakota in 1944 for production of gold, silver, copper, lead, or zinc—worked its group of claims and 50-ton selective-fotation mill in the Whitewood district during the first half of the year. Operations during the latter part of the year consisted of development of the zinc-lead ore reserves to augment the diamond-drilling program conducted by the Federal Bureau of Mines. Production came from the Helen Gould, Iris, and Horus claims. Lead concentrates assaying 1.28 ounces of gold and 27.9 ounces of silver per ton, 40.60 percent lead (wet assay), and 9.10 percent zinc were shipped to the Leadville (Colo.) smelter, and zinc concentrates assaying 0.0687 ounce of gold and 2.557 ounces of silver per ton, 1.05 percent lead (wet assay), and 49.00 percent zinc were shipped to the smelter at Amarillo, Tex. Development in 1944 consisted of 556 feet of drifts, 455 feet of tunnel, and 3,440 feet of diamond drilling.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN TEXAS

(MINE REPORT)

By RICHARD H. MOTE

SUMMARY OUTLINE

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Calculation of value of metal production.....	434	Mines review by counties.....	436
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SUMMARY

Texas mines produced (in terms of recovered metals) 5,355 fine ounces of silver and 230,000 pounds of copper in 1944, having a total value of \$34,858, compared with 4 ounces of gold, 10,284 ounces of silver, 162,000 pounds of copper, and 26,000 pounds of lead in 1943, having a total value of \$30,463. The Hazel mine in Culberson County yielded over half the silver produced in 1944, and copper ore from the Black Shaft mine in Hudspeth County yielded the bulk of the copper. No gold or lead was recovered from ores mined in Texas in 1944; no zinc has been recovered since 1917.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ³	Zinc ³
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940.....	\$35.00	\$0.711+	\$0.113	\$0.050	\$0.063
1941.....	35.00	¢.711+	.118	.057	.075
1942.....	35.00	¢.711+	.121	.067	.093
1943.....	35.00	¢.711+	.130	.075	.108
1944.....	35.00	¢.711+	.135	.080	.114

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was \$20.67+(\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price includes bonus payments by Metals Reserve Co. for overquota production.

⁴ \$0.71111111.

MINE PRODUCTION

The following table shows the annual output of ore and the quantity and value of the metals recovered from Texas mines from 1940 to 1944, as well as the total metal production from 1885 to 1944.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN TEXAS 435

the production of gold, silver, copper, lead, and zinc in Texas, 1940-44, and total, 1885-1944, in terms of recovered metals

Year	Ore (short tons)	Gold		Silver	
		Fine ounces	Value	Fine ounces	Value
1940	146,936	312	\$10,920	1,326,150	\$943,040
1941	140,818	306	10,710	1,096,027	779,397
1942	100,698	236	8,260	672,781	478,422
1943	4,134	4	140	10,284	7,313
1944	4,160	-----	-----	5,355	3,808
1885-1944	(1)	8,281	223,780	33,202,176	23,363,836

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1940	60,000	\$6,780	410,000	\$20,500	-----	-----	\$981,240
1941	12,000	1,416	372,000	21,204	-----	-----	812,727
1942	198,000	23,958	362,000	24,254	-----	-----	534,894
1943	162,000	21,060	26,000	1,950	-----	-----	30,463
1944	230,000	31,060	-----	-----	-----	-----	34,858
1885-1944	1,251	354,221	14,788	489,449	1744	\$106,491	24,537,777

Figures not available.
in short tons.

the production of gold, silver, copper, and lead in Texas in 1944, by counties, in terms of recovered metals

County	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Cherokee	1	326	-----	3,579	4,800	-----
El Paso	2	3,834	-----	1,776	225,200	-----
-----	3	4,160	-----	5,355	230,000	-----
Total, 1944	8	4,134	4	10,284	162,000	26,000

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Texas in 1944, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Dry and siliceous silver ore	2	361	-----	4,086	5,665	-----
Copper ore	1	3,799	-----	1,269	224,335	-----
-----	3	4,160	-----	5,355	230,000	-----
Total, 1944	8	4,134	4	10,284	162,000	26,000

SMELTING AND REFINING PLANTS IN TEXAS

The lead and copper smelters of the American Smelting & Refining Co. in El Paso operated continuously in 1944 and furnished a market for domestic ores and concentrates produced by operators in Arizona, Missouri, New Mexico, Texas, and Virginia and foreign ores and

concentrates from operators in Mexico, Argentina, Canada, Chile, Ecuador, South-West Africa, French Equatorial Africa, and Southern Rhodesia. During 1944 the lead smelter consisted of two blast furnaces having a total annual capacity of 250,000 tons of charge. The copper plant was equipped with two reverberatories, having a total annual capacity of 600,000 tons of charge, and three converters.

The American Smelting & Refining Co. gas-fired horizontal-retort zinc smelter at Amarillo operated throughout the year on zinc concentrates purchased from operators in Arizona, Colorado, New Mexico, Montana, Nevada, and South Dakota and in Mexico. Although the plant is equipped with eight furnaces having a total of 6,400 retorts, a continued shortage of skilled smelter labor during 1944 prevented the company from operating all the furnace blocks. The company electrolytic zinc plant at Corpus Christi, with an annual capacity of 29,000 tons of cathode zinc, operated throughout the year mostly on foreign concentrates, although producers near Hanover, N. Mex., furnished some tonnage.

The gas-fired horizontal-retort zinc smelter of the American Zinc Co. of Illinois at Dumas was operated throughout the year but approximately at half capacity because of the chronic manpower shortage and general quality of the available labor. This plant is equipped with eight furnaces having a total of 6,656 retorts. Concentrates were purchased from operators in Arizona, Colorado, Idaho, New Mexico, and Utah and in Mexico.

The Phelps Dodge Corporation electrolytic copper refinery at El Paso continued to treat blister copper anodes cast at the corporation smelters in Arizona. Part of the refinery product was in the form of fire-refined copper recovered from a portion of the output of the Morenci (Ariz.) copper smelter.

MINES REVIEW BY COUNTIES

Culberson County.—A. P. Williams continued to operate the Hazel mine near the Culberson-Hudspeth County boundary at the south end of the Sierra Diablo Range 14 miles northwest of Van Horn during the first few months of 1944 and shipped 326 tons of dry silver ore, containing 3,579 ounces of silver and 4,909 pounds of copper, to the El Paso smelter.

Hudspeth County.—The Black Shaft mine in the Carrizo Mountains 9 miles northeast of Allamore was operated throughout 1944 by M. F. Drunzer; a total of 3,799 tons of copper ore, containing 1,269 ounces of silver and 232,977 pounds of copper, was shipped to the El Paso smelter. Drunzer also made one small shipment of dry silver ore from the Sancho Panza property 7 miles northeast of Allamore. In the Sierra Blanca district, R. M. Clark did some development on the Bonanza mine in the Quitman Mountains 12 miles west of Sierra Blanca and constructed a small mill to treat an estimated 35,000 tons of dump ore averaging 5 percent zinc and 3 percent lead.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN UTAH

(MINE REPORT)

By G. E. WOODWARD AND PAUL LUFF

SUMMARY OUTLINE

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SUMMARY

Utah mines produced gold, silver, copper, lead, and zinc valued, in terms of recoverable metals, at \$111,036,247 in 1944, an 11-percent decrease from \$124,562,540 in 1943. The total value of these five metals in Utah exceeded that of every other State except Arizona. Utah remained the largest gold-producing State and was second in copper production. A smaller output of each of the five metals resulted in the decrease in total value, although the average prices paid for copper, lead, and zinc were higher than in 1943. Declines were general throughout the State, with the exception of zinc output from the Tintic district and gold production in Tooele County. The value of metal output in the Bingham district declined \$10,513,226 (10 percent) compared with 1943, the Park City region \$1,436,510 (20 percent), and the Tintic district \$911,142 (24 percent). The Utah Copper Co. continued to account for a major part of the value of Utah metal production and in 1944 contributed 77 percent of the total.

Utah metal mines were unable to produce a greater quantity of these metals during 1944 not only because of conditions that were inherent in the mining industry, such as failure in equipment, plant failure, and underground-mine flooding, but of those over which the industry had no control, among which the acute labor shortage was foremost. In 1943 the labor shortage had been alleviated somewhat by the use of soldiers furloughed from the Army, but during 1944 no such help was forthcoming. The shortage, as in other western mines, was the greatest single cause for the decline in output of all metals.

The extent and effect of the shortage can best be judged by the fact that at the end of 1943 a canvass of the major metal producers in the State showed a total of 9,417 employees on the pay roll, whereas these same properties at the end of 1944 showed a total of 7,689 employees, of whom only an average of 7,095 were at work. Absenteeism was epidemic among the major producers in 1944. A canvass at the end of 1944 indicated that the absenteeism average ranged from a high of 19 percent in underground mines to less than 1 percent under the most favorable working conditions; however, the absenteeism

averaged over 7 percent throughout the State. These shortages not only affected current production but limited necessary development to such a point that most underground mines in the State face a period of intense development and exploration before reserves are again normal.

Although most mines in the State were subject to almost monthly revision of quotas for the payment of premiums for overquota production, the general policy of the Government as set forth the latter part of 1943 prevailed throughout 1944. Premium payments to several mines were the only means of rendering continued operation possible, as operating costs had increased considerably beyond the net value of the metals produced, when calculated on the basis of the average market quotations.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ³	Zinc ³
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940.....	\$35.00	\$0.711+	\$0.113	\$0.050	\$0.063
1941.....	35.00	¢ 711+	.118	.057	.075
1942.....	35.00	¢ 711+	.121	.067	.093
1943.....	35.00	¢ 711+	.130	.075	.108
1944.....	35.00	¢ 711+	.135	.080	.114

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price includes bonus payments by Metals Reserve Company for overquota production.

⁴ \$0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Utah, 1940-44, and total, 1864-1944, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1940.....	191	21	27,939,346	355,494	\$12,442,290	12,172,299	\$8,655,857
1941.....	167	12	31,952,817	356,501	12,477,535	11,395,485	8,103,456
1942.....	123	6	34,981,655	391,544	13,704,040	10,574,955	7,519,968
1943.....	110	1	37,386,731	390,470	13,666,450	9,479,340	6,740,864
1944.....	97		30,940,205	344,223	12,047,805	7,593,075	5,399,520
1864-1944.....			(1)	10,184,466	256,681,350	708,947,521	516,415,620

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1940.....	463,728,000	\$52,401,264	151,376,000	\$7,568,800	87,576,000	\$5,517,288	\$66,585,499
1941.....	533,676,000	62,973,768	139,202,000	7,934,514	84,098,000	6,307,350	97,796,823
1942.....	613,382,000	74,219,222	143,860,000	9,638,620	91,086,000	8,470,988	113,552,848
1943.....	647,978,000	84,237,140	130,514,000	9,788,550	93,792,000	10,129,536	124,562,540
1944.....	565,150,000	76,295,250	105,038,000	8,403,040	77,988,000	8,890,632	111,036,247
1864-1944.....	24,559,781	1,274,240,963	24,347,512	475,542,052	2921,089	123,333,793	2,646,213,768

¹ 1864-1901: Figures not available; 1902-44: 524,674,574 tons produced.

² Short tons.

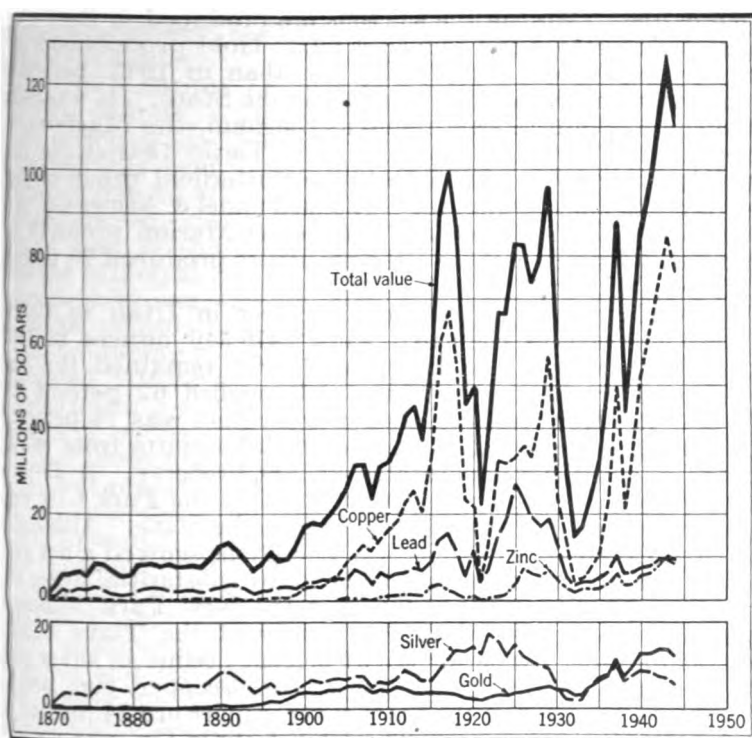


FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc, and total value in Utah, 1870-1944.

Gold.—Utah was again the largest gold-producing State; however, the output was 344,223 fine ounces, a 12-percent decline from 390,470 ounces in 1943. Gold produced in Utah is derived principally from base-metal ores; in 1944, copper, zinc-lead, lead, zinc-lead-copper, and zinc ores furnished 94 percent of the total and siliceous ores the remainder. No gold was recovered from placer operations in 1944. Mines in the Bingham district, by far the most important gold-producing area in the United States now active, produced 312,493 ounces of gold, a decrease of 31,058 ounces compared with 1943. The loss in the district can be attributed to a smaller output from each of the major gold-producing mines in the district except the National Tunnel & Mines Co. operation; however, the gain from this operation was small. These losses in gold output resulted from a smaller tonnage of ore from each producing mine, as the gold content of the ore mined in 1944 remained substantially the same as in 1943. The Park City region was the second most important gold-producing area in the State in 1944 and produced 15,149 ounces compared with 19,559 in 1943. Most of the decrease was due to a decline at the New Park Mining Co. operations. The tonnage of ore mined was not only smaller than in 1943, but the emphasis was on zinc-lead ore at the expense of higher grade gold ores at the company's disposal. The Tintic district—source of most of the siliceous gold ore in normal times—produced 11,417 ounces in 1944, a decline of 11,053 ounces from 1943. Mines in Tooele County showed a slight increase

in gold output. Most of the siliceous ore produced in the State was used as reverberatory and converter flux. Gold production from the Utah Copper Co. was considerably less than in 1943; nevertheless the company was the leading producer in the State. It was followed by the United States & Lark mines at Bingham, the Mayflower mine at Keetley, the Tintic Bullion mine in the Tintic district, the Boston Consolidated property at Bingham, the Butterfield group of properties in the Bingham district, the National Tunnel & Mines Co. properties in the Bingham district, and the Geyser Marion property in the Camp Floyd district. These eight properties produced 96 percent of the State gold output.

Silver.—The output of recoverable silver in Utah in 1944 was 7,593,075 fine ounces compared with 9,479,340 ounces in 1943, a 20-percent decrease. The Bingham district remained the leading silver-producing area in the State and supplied 62 percent of the State output. However, the district production was 14 percent less than in 1943, owing chiefly to much smaller outputs from the Utah Copper Co. and the United States & Lark property. A 29-percent decline was noted in the output from mines in the Park City region, the second leading silver-producing area in the State. Although the Park Utah Consolidated Mining Co. operations showed a net gain in silver production, it was more than offset by substantial losses at the Silver King Coalition Mines Co. and the New Park Mining Co. properties. A decrease of 339,548 ounces at the Tintic Standard mine was the chief reason for the 31-percent decline in silver output from the Tintic district. Zinc-lead, zinc-lead-copper, zinc, and lead ores yielded 53 percent of the State silver, copper ore 34 percent, and siliceous ores the remainder. The Utah Copper Co. was again the leading silver producer in Utah and was followed by the United States & Lark, Park Utah Consolidated, Silver King Coalition, Mayflower, Tintic Standard, Chief No. 1, West Calumet, Harold dump, and Godiva mines. These 10 properties contributed 90 percent of the State total output of silver.

Copper.—The output of recoverable copper in Utah was 565,150,000 pounds in 1944 compared with 647,978,000 pounds in 1943, a 13-percent decrease. Although all the principal copper-producing operations except the National Tunnel & Mines Co. showed decreased output, the Utah Copper Co. showed by far the greatest. The Utah Copper Co. mined a total of about 66,000,000 tons of ore and waste, at the rate of $1\frac{1}{4}$ tons of waste to a ton of ore, in 1944 compared with about 80,000,000 tons in 1943. The operations at the open-pit mine at Bingham were continuous except for brief stoppages necessitated by the closing of the concentrating mills at Arthur and Magna. The copper content of the ore treated in 1944 was about the same as that treated during the previous year. Copper ore mined in Utah totaled 29,930,659 tons compared with 35,999,656 tons in 1943; the total value of gold, silver, copper, and lead recovered from copper ore and precipitates was \$87,401,850 in 1944, or 79 percent of the State value of all five metals. In addition, copper ore yielded a considerable quantity of molybdenum sulfide, exceeded only by the quantity recovered by the Climax Molybdenum Co. in Colorado.

All the Utah mines producing over 1,000,000 pounds of recoverable copper in 1944 are in the Bingham district and include the Utah Copper Co. (over 97 percent of State output), the National Tunnel

Mines Co. property, the Ohio Copper Co. property, and the United States & Lark mines.

Lead.—The output of recoverable lead in Utah in 1944 was 1,388,000 pounds, a 20-percent decrease from 1943. During the year the principal lead-producing mines in the State had the greatest shortage of labor ever experienced by them. This shortage, as well as stoppages due to other causes, and the fact that in June the mines began working one shift a day rather than two resulted in the lowest output of lead in the State since 1921. The Bingham district remained the principal lead-producing area, with an output of 62,337,000 pounds; however, this production represents a decrease from 1943 of 18,536,300 pounds in consequence of reduced output from all the principal producing properties except that of the Montana Bingham Consolidated Mining Co. The mines in the Park City region were the second leading source of lead in the State and produced 23,319,600 pounds, or 27 percent less than in 1943; each of the large producers in the district showed a decrease, of which the largest—about 5,900,000 pounds—was reported by the Silver King Coalition Mines Co. The Tintic district, third-largest source of lead in the State, produced 1,687,700 pounds, a decrease of 36 percent compared with 1943; the decline in output of this district was caused by a much smaller production from the Tintic Standard mine, which more than offset slight gains at the Chief Consolidated Mining Co. property. A considerable quantity of siliceous ore containing 3 to 4 percent lead was shipped from mines and tailings dumps in the Tintic district to be used as flux at copper smelters in the Salt Lake Valley. Recoverable lead from this source aided materially in counterbalancing the losses from lead properties in the district. The United States & Lark property in the Bingham district was by far the most important source of lead in the State. It was followed by the Park Utah Consolidated group, the Mayflower and Silver King Coalition mines in the Park City region, the West Calumet mine in Tooele County, the Chief Consolidated Mining Co. property and the Tintic Standard mine in the Tintic district, the Montana Bingham Consolidated group and the Butterfield group in the Bingham district, and the Harold dump in the Tintic district. These 10 properties produced 95 percent of the State total lead output.

Zinc.—The output of recoverable zinc from Utah mines was 77,988,000 pounds compared with 93,792,000 pounds in 1943, a 17-percent decrease. Decreases were noted in all the principal zinc-producing districts except the Tintic, from which production is comparatively small. The Bingham district showed a decline of 18 percent, caused principally by losses at the United States & Lark mines and the Butterfield group of properties. The principal zinc-producing mines in the Park City region, except the Park Utah Consolidated mine, reported decreases; however, the slight gain at the Park Utah Consolidated was insufficient to offset losses at the Silver King Coalition and New Park Mining Co. properties. The gain in zinc output from the Tintic district is attributed almost solely to the operation on the lower levels of the Chief No. 1 mine of the Chief Consolidated Mining Co., which contributed virtually all the zinc output of the district. All zinc and zinc-lead concentrates produced in Utah in 1944 were treated at the Anaconda and Great Falls (Mont.) zinc plants of the Anaconda Copper Mining Co. Zinc fume derived from the fum-

ing of current slag, cold slag, and crude ore was dealed and the shipped to Bartlesville, Okla., for further treatment. The United States & Lark property was the principal zinc producer in Utah in 1944. It was followed by the Tooele slag-fuming plant, the Park Utah Consolidated Mining Co. property, the Mayflower mine, the China No. 1 mine, the West Calumet mine, the Silver King Coalition mine, and the Butterfield group of properties. These eight properties furnished 96 percent of the State output of zinc.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Utah in 1944, by county: in terms of recovered metals

County	Mines producing ¹	Ore (short tons)	Gold		Silver	
			Fine ounces	Value	Fine ounces	Value
Beaver	10	7,021	147	\$5,145	33,975	\$24,169
Box Elder	3	651	12	420	855	608
Grand	1	8			7	
Iron	1	750	6	210	405	355
Juab	12	102,008	2,184	76,440	442,260	314,490
Millard	1	112			7	
Piute	4	508	265	9,275	4,486	3,190
Salt Lake	15	30,345,477	312,528	10,938,480	4,680,090	3,328,064
San Juan	1	8,009	1	35	135	96
Sevier	1	17				
Summit	6	138,431	1,247	43,645	938,565	667,424
Tooele	23	158,475	4,685	163,975	364,680	259,328
Utah	15	113,549	9,244	323,540	636,255	452,448
Wasatch	2	64,570	13,902	486,570	491,085	349,216
Washington	1	596	2	70	90	64
Wayne	1	14			90	64
Total, 1943	97	30,940,205	344,223	12,047,805	7,593,075	5,399,520
	111	37,386,731	390,470	13,666,450	9,479,340	6,740,864

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaver	98,600	\$13,311	445,000	\$35,600	291,000	\$33,174	\$111,390
Box Elder	25,000	3,375	90,200	7,216	107,500	12,255	23,874
Grand	200	27					32
Iron	3,600	486	124,900	9,992	205,000	23,370	34,410
Juab	243,800	32,913	4,482,900	358,632	6,870,500	783,237	1,565,718
Millard			1,800	144	43,500	4,959	5,108
Piute	2,000	270	33,600	2,688	9,500	1,083	16,506
Salt Lake	562,210,200	75,898,377	62,402,900	4,992,232	38,345,500	4,371,387	99,528,540
San Juan	270,400	36,504					36,635
Sevier			100	8	3,000	342	350
Summit	440,400	59,454	14,355,900	1,148,472	10,050,000	1,145,700	3,064,695
Tooele	280,000	37,800	7,863,000	629,040	12,737,500	1,452,075	2,542,218
Utah	825,800	111,483	6,273,900	501,912	284,000	30,096	1,419,479
Wasatch	516,400	69,714	8,963,700	717,096	9,061,000	1,032,954	2,655,550
Washington	233,000	31,455	100	8			31,597
Wayne	600	81					145
Total, 1943	565,150,000	76,295,250	105,038,000	8,403,040	77,988,000	8,890,632	111,036,247
	647,978,000	84,237,140	130,514,000	9,788,550	93,792,000	10,129,536	124,562,540

¹ All lode mines in 1944; no placers operated in 1944, but 1 placer in 1943.

² Includes 4 ounces (\$140) of placer gold in Millard County.

MINING INDUSTRY

The production of copper ore dominates the mining industry in Utah, and in 1944 it represented 97 percent of the State total output of ores of all classes herein reported. The Bingham district produced

of all classes representing 98 percent of the State total. Of the 14,838 tons of ore of all classes produced from mines in the Bingham district, copper ore constituted 99 percent, and zinc-lead ore and siliceous ore nearly all the remainder. The grade of copper ore mined during the year was about the same as in 1943, but the zinc-lead ore was of a higher lead but lower zinc content. The bulk of ore produced from mines in the Park City region was zinc-lead ore, although substantial tonnages of zinc tailings were milled and siliceous tailings were shipped direct to smelters. The ore mined in the Park City region showed an increase in copper, lead, and zinc content compared with 1943. Zinc-lead ore for the first time was the chief product of metal mining in the Tintic district. Almost all the ore of this class came from the lower workings of the Chief No. 1 mine. There were substantial decreases in output of siliceous ore from mines in the Tintic district, and at least half of such ore came from mine dumps. The quantity of siliceous ore (available for smelters) that was mined throughout the State was much smaller than in 1943. The largest declines were noted in the Tintic district in Juab and Utah Counties and the Camp Floyd district in Tooele County; however, these two districts continued to supply most of the siliceous ore of the State.

The mining industry in Utah continued to receive considerable aid from various Government agencies. The Bureau of Mines gave much engineering assistance to both metal and nonmetal mines in 1944 and in addition assisted materially in exploring and developing many properties. The Grazing Service completed the construction of 173 miles of access roads to metal mines in Utah at an average cost of \$2157 per mile. The Reconstruction Finance Corporation continued its program of giving financial assistance to mines considered capable of producing needed minerals.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Utah in 1944, with content in terms of recovered metals

Source	Mines producing ¹	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lead and siliceous gold ore.....	9	47, 410	10, 266	90, 075	946, 613	454, 503	-----
Lead and siliceous gold-silver.....	23	157, 271	7, 817	439, 765	735, 085	2, 880, 798	-----
Lead and siliceous silver ore.....	24	36, 656	1, 405	476, 046	305, 425	2, 148, 228	6, 191
.....	56	241, 337	19, 488	1, 005, 886	1, 987, 123	5, 483, 529	6, 191
Copper ore.....	14	29, 930, 659	286, 013	2, 565, 851	2, 559, 615, 518	233, 685	-----
.....	29	15, 926	2, 169	142, 265	88, 194	4, 441, 295	5, 040
.....	6	95, 968	33	12, 241	4, 792	828, 657	8, 810, 433
.....	30	656, 065	36, 508	3, 864, 164	3, 434, 363	94, 001, 323	69, 106, 378
.....	1	250	12	2, 668	20, 010	49, 511	59, 949
.....	4	97, 30, 940, 205	344, 223	7, 593, 075	2, 565, 150, 000	105, 038, 000	77, 988, 000
Total, 1943.....	111	37, 386, 731	390, 470	9, 479, 340	9, 647, 978, 000	130, 514, 000	93, 792, 000

¹All the mines in 1944; no placers operated in 1944, but 1 placer in 1943.

²Includes 35,936,977 pounds recovered from mine-water precipitates.

³Includes 6,890 tons of zinc slag.

⁴A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

⁵Includes 7,467,429 pounds recovered from mine-water precipitates.

METALLURGIC INDUSTRY

The mills, smelters, and slag-fuming plant in the Salt Lake Valley area represented the largest aggregation of custom reduction plants for complex ores in the United States. Custom milling capacity of the concentrating mills in the Valley area was about 3,800 tons of ore per day; of this total only about half was utilized in 1944.

In 1944 mines in Utah produced 30,940,205 tons of ore, treated as follows: 30,632,016 tons at concentrating mills, compared with 36,880,347 tons in 1943; 259,309 tons of ore shipped crude to smelters, compared with 397,342 tons in 1943; and 48,880 tons of slag fumed, compared with 109,042 tons in 1943.

Eleven concentrating mills were active in Utah during 1944; 5 of these plants (Arthur, Magna, Ohio Copper, Tooele, and Big Indian) treated 29,927,992 tons of copper ore and old tailings; 4 mills (Bauer, Midvale, Silver King, and Tooele), with a combined rated capacity of about 4,600 tons daily, treated 658,015 tons of ore (mostly lead, zinc-lead, zinc-lead-copper, and zinc); 1 gravity concentration mill treated 9 tons of silver ore; and 1 flotation mill in Summit County treated 46,000 tons of current zinc tailings. The 3 large custom milling plants—Midvale concentrator, Tooele concentrator, and Bauer concentrator—treated most of the zinc-lead, zinc-lead-copper, lead, and zinc ore milled in Utah in 1944. Each plant had available from company-owned mines the major part of the plant feed. Most of the feed for the Midvale concentrator came from the company-owned mines in the Bingham district, principally the United States & Lark mines; the greatest part of the mill feed at the Bauer mill came from company-owned mines in the Rush Valley and Bingham districts in Utah and the Triumph mine in Idaho; and the Tooele concentrator received most of its mill feed from the Park Utah Consolidated property in the Park City region. In addition to the ores received from mines in Utah, these mills received substantial quantities of ore from mines in California, Nevada, Colorado, Montana, Idaho, and Arizona. The Tooele concentrator at Tooele, owned and operated by the International Smelting & Refining Co., comprised three sections each of 500-ton daily rated capacity—a copper section, an oxide lead section, and a zinc-lead section. The zinc-lead section or oxide lead section was also used at times to treat zinc-copper ore. The zinc-copper ore supply came from California mines. The feed to the copper section came almost exclusively from the National Tunnel & Mines Co. operation; the feed to the oxide lead section came from the Tintic Standard mine; and the feed to the zinc-lead section came principally from the Park Utah Consolidated property at Park City.

Two copper smelters—the Garfield plant of the American Smelting & Refining Co. and the Tooele smelter of the International Smelting & Refining Co.—were active throughout 1944, except for brief periods of shut-down caused by labor difficulties. The combined rated capacity of these plants remained at about 1,900,000 tons of charge a year. The Garfield smelter received almost the entire output of the Utah Copper Co., which represented by far the largest part of its charge. In 1944 the sulfuric acid plant, operated in conjunction with the Garfield smelter, was enlarged to meet a greater demand for acid

petroleum refineries and fertilizer plants. The Tooele copper plant treated concentrates and ores principally from the National Fuel & Mines Co. operation.

Three lead smelters—the Midvale smelter operated by the United States Smelting, Refining & Mining Co., the Tooele smelter operated by the International Smelting & Refining Co., and the Murray smelter operated by the American Smelting & Refining Co.—were active throughout 1944. The combined rated operating capacity of these three plants was about 70,000 tons of charge per year. The Murray plant treated lead concentrates, lead ores, and siliceous ores mostly from mines in Idaho and Utah. The Midvale plant treated lead concentrates, lead ores, and siliceous ores mostly from its company-owned properties in Utah. The Tooele plant, operated in conjunction with the Tooele slag-fuming plant, treated zinc-lead ore and zinc-copper ore, lead concentrates and zinc concentrates, and residues from company-owned operations as well as custom sources; the combinations of these two plants were the most versatile metallurgical operation in the Salt Lake Valley area and continued to offer a market for ores that otherwise might have been unsalable.

Net production of metals in Utah in 1944, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Concentrates smelted.....	1,076,694	322,572	6,445,172	526,738,453	95,911,771	77,174,141
Slag fumed.....	48,880					
Waste smelted.....	259,309	21,651	1,147,903	2,474,570	9,126,229	813,859
Waste-water precipitates smelted.....	21,925	-----	-----	35,936,977	-----	-----
Total, 1943.....	-----	344,223	7,593,075	565,150,000	105,038,000	77,988,000
		390,470	9,479,340	647,978,000	130,514,000	93,792,000

All from Salt Lake County.

Gross metal content of concentrates produced from ores mined in Utah in 1944, by classes of concentrates smelted

Class of concentrates	Concentrates (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Copper.....	817,794	285,931	2,546,845	534,050,399	838,549	-----
Lead.....	75,137	16,340	2,966,374	2,480,795	84,850,865	6,974,965
Lead-copper.....	19	5	806	5,221	19,853	3,609
Zinc.....	30,720	2,950	182,036	299,810	1,806,298	33,847,317
Zinc-lead.....	39,812	2,972	300,223	875,955	5,549,867	41,246,617
Dry iron (from zinc-lead ore).....	113,212	14,353	443,360	810,012	7,299,244	6,940,402
Total, 1943.....	1,076,694	322,551	6,439,644	538,522,192	100,364,676	89,012,910
	1,277,578	352,774	7,464,694	632,024,775	120,380,236	102,032,552

Mine production of metals from concentrating mills in Utah in 1944, in terms of recovered metals

BY COUNTIES

	Ore milled (short tons)	Concentrates smelted and recovered metal					
		Concen- trates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaver.....	1, 118	306	6	4, 873	848	51, 017	218, 267
Juab.....	80, 467	20, 075	803	232, 785	47, 483	4, 259, 508	6, 870, 500
Piute.....	231	40	10	1, 480	1, 227	15, 373	9, 500
Salt Lake.....	30, 297, 732	983, 942	304, 886	4, 568, 935	525, 344, 039	60, 805, 411	38, 229, 628
San Juan.....	8, 009	528	1	135	270, 400	-----	-----
Summit.....	132, 425	21, 772	1, 082	879, 749	408, 575	13, 612, 754	9, 965, 663
Tooele.....	41, 744	21, 301	1, 686	210, 248	135, 619	5, 459, 387	4, 199, 583
Utah.....	5, 720	3, 087	175	50, 354	10, 662	1, 960, 121	264, 000
Wasatch.....	64, 570	25, 643	13, 902	491, 085	516, 400	8, 963, 700	9, 061, 000
Total, 1943....	30, 632, 016 36, 880, 347	1, 076, 694 1, 277, 578	322, 551 352, 774	6, 439, 644 7, 464, 694	526, 735, 253 615, 285, 416	95, 127, 271 113, 779, 652	68, 818, 141 79, 194, 762

BY CLASSES OF CONCENTRATES SMELTED

Copper.....	817, 794	285, 931	2, 546, 845	523, 311, 107	203, 343	-----
Lead.....	75, 137	16, 340	2, 966, 374	1, 739, 653	81, 943, 290	1, 250, 681
Lead-copper.....	19	5	806	3, 394	19, 059	-----
Zinc.....	30, 720	2, 850	182, 036	284, 086	1, 645, 608	30, 445, 854
Zinc-lead.....	39, 812	2, 972	300, 223	832, 157	5, 050, 380	37, 121, 606
Dry iron (from zinc-lead ore).....	113, 212	14, 353	443, 360	564, 856	6, 265, 591	-----
	1, 076, 694	322, 551	6, 439, 644	526, 735, 253	95, 127, 271	68, 818, 141

Gross metal content of Utah crude ore shipped to smelters in 1944, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold.....	47, 410	10, 266	90, 075	967, 325	747, 340	-----
Dry and siliceous gold-silver.....	157, 271	7, 817	439, 765	754, 320	4, 755, 579	-----
Dry and siliceous silver.....	36, 647	1, 405	476, 039	317, 333	3, 151, 575	9, 004
Copper.....	2, 667	82	19, 006	375, 610	60, 690	-----
Lead.....	11, 609	2, 013	97, 884	112, 681	2, 743, 575	7, 396
Zinc.....	159	-----	49	-----	4, 070	69, 189
Zinc-lead.....	3, 429	67	23, 606	33, 280	986, 531	996, 904
Zinc-lead-copper.....	117	1	1, 476	14, 920	27, 083	39, 882
Total, 1943.....	259, 309 397, 342	21, 651 37, 674	1, 147, 960 2, 007, 979	2, 575, 469 4, 939, 444	12, 466, 443 20, 852, 444	1, 122, 375 1, 197, 282

Production of metals from Utah crude ore shipped to smelters in 1944, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Albany	5,903	141	29,102	97,752	393,983	72,733
Beaver	651	12	855	25,000	90,200	107,500
Benet	8	—	7	200	—	—
Box	759	6	495	3,600	124,900	205,000
Carroll	21,541	1,381	209,475	196,317	223,392	—
Chase	112	—	7	—	1,800	43,500
Craig	277	255	3,006	773	18,227	—
East Lake	47,745	7,642	111,155	929,184	1,597,489	115,872
East	17	—	—	—	100	3,000
Franklin	6,006	165	58,816	31,825	743,146	84,337
Garfield	67,851	2,978	148,904	141,181	1,619,113	181,917
Hatch	107,829	9,069	585,901	815,138	4,313,779	—
Huntington	596	2	90	233,000	100	—
Kane	14	—	90	600	—	—
Total, 1944	259,309	21,651	1,147,903	2,474,570	9,126,229	813,859
	397,342	37,674	2,007,979	4,695,155	15,261,148	750,738

BY CLASSES OF ORE

Gold and siliceous gold	47,410	10,266	90,075	946,613	454,503	—
Gold and siliceous gold-silver	157,271	7,817	439,765	735,085	2,880,798	—
Gold and siliceous silver	36,647	1,405	476,039	305,425	2,147,628	6,191
Copper	2,667	82	19,006	367,434	30,342	—
Lead	11,609	2,013	97,884	79,500	2,614,045	5,049
Zinc	159	—	7	—	3,100	52,000
Lead-silver	3,429	67	23,651	27,833	969,204	721,764
Lead-copper	117	1	1,476	12,680	26,609	28,855
	259,309	21,651	1,147,903	2,474,570	9,126,229	813,859

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Utah in 1944, by counties and districts, in terms of recovered metals

County and district	Mines (all lode) producing 1	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
Beaver County:								
Beaver Lake.....	1	32	---	7	2,000	---	---	\$275
Pine Grove.....	1	102	---	150	200	7,100	6,000	1,392
Rocky.....	1	422	10	914	23,000	---	---	4,105
San Francisco.....	4	3,375	109	13,050	31,000	175,000	11,500	32,672
Star and North Star.....	2	3,067	28	19,717	40,800	262,400	273,500	72,680
Washington.....	1	23	---	128	1,000	---	---	266
Box Elder County:								
Crater Island.....	1	48	8	76	2,400	---	---	658
Luch.....	1	200	3	680	22,600	7,800	2,000	4,498
Promontory.....	1	403	1	90	---	82,400	105,500	18,718
Grand County: Unorganized (Thompson).	1	8	---	7	200	---	---	32
Iron County: Indian Peak.....	1	759	.6	495	3,600	124,900	205,000	34,410
Juab County:								
Detroit.....	1	53	3	149	2,400	---	---	535
Fish Springs.....	1	20	---	3,084	---	15,500	---	3,433
Mount Nebo.....	1	1	---	7	---	1,000	---	85
Tintic ²	9	101,934	2,181	439,020	241,400	4,466,400	6,870,500	1,561,665
Millard County: House Mountains or Notch Peak.	1	112	---	7	---	1,800	43,500	5,108
Plute County:								
Mount Baldy.....	1	257	251	2,911	600	17,800	---	12,360
Ohio.....	3	241	14	1,575	1,400	15,800	9,500	4,146
Salt Lake County:								
Big Cottonwood.....	2	119	1	668	800	43,400	43,500	9,049
Little Cottonwood.....	2	210	8	7,740	9,600	7,400	---	8,302
Smelter.....	(³)	310	26	204	800	14,800	---	1,717
West Mountain.....	11	30,344,838	312,493	4,671,478	562,190,000	62,337,300	38,302,000	99,509,472
San Juan County: La Sal.....	1	8,009	1	135	270,400	---	---	36,635
Sevier County: Salina Creek.....	1	17	---	---	---	100	3,000	36,350
Summit County: Uintah.....	6	138,431	1,247	988,565	440,400	14,355,900	10,050,000	3,064,695
Tooele County:								
Camp Floyd.....	2	42,211	1,926	71,865	---	43,500	---	118,514
Clifton.....	2	11,835	241	7,349	10,800	---	---	18,599
Dugway.....	2	11,970	17	1,717	2,200	198,300	127,000	32,455
Free Coinage.....	1	9	---	7	---	155,800	---	53
Lakeside.....	1	680	3	512	1,200	---	---	13,095
North Tintic.....	1	30	---	---	---	1,200	5,500	723
Orbik.....	6	6,095	100	53,460	128,000	729,600	157,500	135,119
Rush Valley.....	7	96,290	1,975	227,506	136,600	6,585,700	12,447,500	2,195,219
Silver Islet.....	1	1	---	45	---	---	---	48
Willow Springs.....	1	354	423	2,219	1,200	148,100	---	28,393
Utah County:								
American Fork.....	2	1,016	8	5,061	1,000	102,600	235,500	39,069
Tintic ²	13	112,533	9,236	631,194	824,800	6,171,300	28,500	1,380,410
Wasatch County: Snake Creek.....	2	64,570	13,902	491,085	516,400	8,963,700	9,061,000	2,655,550
Washington County: Tutuaguet.....	1	596	2	90	233,000	100	---	31,597
Wayne County: Hanksville.....	1	14	---	---	600	---	---	145
Total Utah.....	97	30,940,205	344,223	7,593,075	565,150,000	105,038,000	77,988,000	111,036,947

¹ No placers operated in 1944.
² Tintic district lies in both Juab and Utah Counties.
³ Property not counted as a "mine"; material crushed for use in cement.

BEAVER COUNTY

Pine Grove district.—The only output from the Pine Grove district in 1944 was zinc-lead ore from the Wah Wah mine shipped to the Midvale (Utah) flotation concentrator.

Bucky district.—The Prosper Mining Co. operated its Old Hickory mine in 1944 from March through November and shipped 422 tons of siliceous copper ore to the Garfield smelter.

San Francisco district.—A total of 3,222 tons of material from the Horn Silver mine dump was shipped direct to smelters in 1944; the material comprised 3,075 tons of siliceous gold-silver ore and 147 tons of lead ore. Considerable work was done during the year in timbering the King David shaft and connecting this shaft with the adjoining Horn Silver mine workings. Production from the Horn Silver mine, operated through the King David shaft, is anticipated during 1945. Other production in the district during 1944 was mostly waste copper ore shipped direct to smelters from the Imperial group and Cactus properties.

Star and North Star district.—James D. Williams, lessee of the Harrington-Hickory mine, operated the property throughout 1944. The output comprised 380 tons of silver ore, 595 tons of lead ore, and 56 tons of zinc-lead ore, all of which was shipped to smelters; in addition, 87 tons of zinc-lead ore were shipped to the Midvale concentrator for milling. Most of the ore shipped was oxidized. Lessees operated the Moscow Silver Mines Co. property and shipped 820 tons of silver ore to the Garfield smelter and 929 tons of rich zinc ore to the Bauer mill.

BOX ELDER COUNTY

Crater Island district.—Some copper ore was shipped direct to the Garfield smelter from the Copper Blossom property.

Lucin district.—A lessee shipped copper ore (125 tons), silver ore (40 tons), and lead ore (35 tons) direct to smelters from the Copper Mountain property.

Promontory district.—The Lakeview Mining Co. shipped oxidized zinc-lead ore from the Lake View Carbonate mine to the Tooele lead smelter.

IRON COUNTY

Indian Peak district.—The only output from Iron County in 1944 came from the New Arrowhead Mining Co. which operated its Arrowhead property throughout the year. The production consisted of 759 tons of oxidized zinc-lead ore which was shipped to the Tooele lead smelter.

JUAB COUNTY

Detroit district.—The Detroit district lies in both Juab and Millard Counties, but in 1944 all the production came from the Juab County section and was gold-silver ore from the Copperhead mine shipped to the Garfield smelter.

Fish Springs district.—Lessees shipped some lead ore to the Murray smelter from the Utah Mines group.

Tintic district.—The Tintic district, which lies in both Juab and Utah Counties, is reviewed here. The table that follows gives the metal production in each section of the district in 1944, a comparison with the total in 1943, and the grand total from 1869 to 1944.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Juab and Utah Counties, Utah, 1943-44, and total, 1869-1944, in terms of recovered metals

	Mines pro- ducing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
1944								
Juab County.....	9	101,934	2,181	439,020	241,400	4,466,400	6,870,500	\$1,561,665
Utah County.....	13	112,533	9,236	631,194	824,800	6,171,300	28,500	1,380,410
Total, 1943.....	22	214,467	11,417	1,070,214	1,066,200	10,637,700	6,899,000	2,942,075
	20	269,111	22,470	1,554,989	1,681,700	16,522,000	4,659,500	3,853,217
Total, 1869-1944.....	(1)		2,556,038	258,109,570	241,377,064	1,845,524,079	55,720,138	387,574,607

¹ Figures not available.

During 1944, as in previous years, the Tintic district was the principal source in the State of highly siliceous ores that are used both as reverberatory and converter flux at the copper smelters in the Salt Lake Valley. However, in 1944 the output of such material was substantially less than in former years and much was dump material. The emphasis was on base-metal ores, particularly zinc-lead ores, and the zinc output of the district was greater than in any other year.

The Chief Consolidated Mining Co. operated its Chief No. 1 property in Juab County throughout the year; and the company Gemini, Eureka Hill, and Plutus mines were idle. Almost all the output from the Chief No. 1 mine was zinc-lead ore and was extracted from the 1,800- to the 2,250-foot level; in addition, a small quantity of siliceous silver ore and lead ore was shipped to the Garfield smelter.

The output of zinc-lead ore from the Chief No. 1 mine was nearly double that in 1943, and all was shipped to the Bauer custom mill of the Combined Metals Reduction Co. for treatment. According to the company report, the production in 1944 comprised 80,154 tons of zinc-lead ore and 360 tons of siliceous ore, a total of 80,514 tons of ore containing 1,322 ounces of gold, 291,479 ounces of silver, 77,303 pounds of copper, 5,076,239 pounds of lead, and 10,232,763 pounds of zinc.

According to the company printed annual report for the year ended December 31, 1944, pumping operations have resulted in lowering the water in the Chief No. 1 until now the company is mining below the 2,250-foot level and has sufficient control of the mine water to proceed at depth. The control of the water in the Chief No. 1 mine has been a problem of major proportions, and the work incident to its solution was concluded in 1944.

Because of the extreme labor shortage the development program of the Chief Consolidated Mining Co. was limited by necessity to its Chief No. 1 mine. In 1944 a total of 7,365 feet of development—5,222 feet of drifts, 1,880 feet of raises, and 263 feet of winzes—was completed. The company printed annual report states further that every effort has been extended toward mining the zinc-lead ore bodies below the water level, hence the development program on areas within the company property of 10,000 acres has had to be postponed until the present deficiency in the strategic metal situation has been relieved. However, when this occurs the company intends to resume development in the upper levels of the Chief No. 1, Apex Standard, Eureka Hill, and Gemini mines.

The Mammoth Mining Co. was the second most important producer in the Juab County section of the Tintic district in 1944; the company shipped about 17,000 tons of siliceous gold-silver ore to the Garfield smelter. Philip P. Clark operated the Godiva mine under lease throughout the year and shipped 3,017 tons of high-grade siliceous silver ore to Garfield. Lessees operated the Dragon & Martha Washington and the Empire groups, both owned or controlled by the International Smelting & Refining Co., and 458 tons of siliceous ores were shipped to smelters from these properties. None of the properties owned or controlled by the United States Smelting, Refining & Mining Co. were active in 1944. Other production in the Juab County section of the Tintic district included zinc-lead milling ore from the Showers group and Alaska mine and ore of several classes from the Showers group and the Windridge and Esther mines, all of which was shipped to smelters.

The major part of the recoverable metal output of the Utah County section of the Tintic district in 1944 was contained in ores produced by the Tintic Standard Mining Co. and its subsidiary companies. The following operating details were taken in part from the company printed annual report for the year ended December 31, 1944. Ore produced by the Tintic Standard mines (including the Iron Blossom) was 28,145 tons, 29,560 tons less than in 1943.

Operations during 1944 were limited by such a serious shortage of underground men, particularly those directly engaged in production, that output was below that necessary for profitable production. The shortage of mine labor prevailed throughout the State, but operations of the Tintic Standard Mining Co. were acutely affected by the increased employment available in new industrial plants and at surface jobs for men living in the towns and districts from which most of the company crews are obtained.

The shortage of labor, in addition to curtailing production substantially, made it necessary to suspend important development. Drifting on the 1,570-foot level and in the Tintic Standard-North Lily Development Unit was suspended. Because no improvement in the labor situation was anticipated in the near future, near the end of 1944 certain sections of the Tintic Standard mine were allotted to leasers, and production improved. This type of operation is expected to be extended in 1945. The Eureka Lilly mines were again operated only by lessees; production amounted to 7,371 tons of siliceous gold-silver ore, which was shipped direct to the Garfield smelter. The Colorado Consolidated Mines Co. property was operated also on lessee account, and production amounted to 6,982 tons of siliceous gold-silver ore shipped to Garfield. All operations were carried on in areas of the mine adjacent to the No. 4 and No. 1 shafts. The improvement and rehabilitation program started in 1943 was completed in 1944, with the result that output from this mine was increased greatly.

Development of the area owned by the Eureka Lilly Consolidated Mining Co. and the Twentieth Century Mining Co. was suspended during the latter part of 1944 by the Tintic Standard Mining Co. and the North Lily Mining Co., owing to shortage of labor. The Development Unit is the result of, and in accordance with, a joint development program undertaken by the Tintic Standard Mining Co. and the North Lily Mining Co. Production in 1944, before development was suspended, totaled 677 tons of copper ore from the Twentieth Century

mine shipped to the Garfield smelter. Development in 1944 totaled 836 feet of drifts, 101 feet of raises, 7 feet of shafts, 1,049 feet of diamond drilling, and 20 feet of long-hole drilling. Development in all other properties of the Tintic Standard Mining Co., exclusive of development at the Cougar (fluorspar) mine, comprised completion of 3,562 feet of drifts, 614 feet of raises, 68 feet of shafts, 575 feet of diamond drilling, and 2,745 feet of long-hole drilling.

An aggregate of 43,175 tons of ore of all classes was mined in 1944 by the Tintic Standard Mining Co. and its subsidiary companies and lessees, including the Development Unit. This output compared with a total of 73,296 tons mined in 1943 from the same sources. The total metal content in 1944 was 2,587 ounces of gold, 399,568 ounces of silver, 459,141 pounds of copper, and 5,183,255 pounds of lead. Over 4,000 tons of lead ore from the Tintic Standard mine were milled at the Tooele concentrator, making a lead concentrate and a siliceous tailing. The purpose served by milling this lead ore was to eliminate much of the silica from the lead blast-furnace charge.

The American Smelting & Refining Co. continued to ship siliceous gold-silver ore from the Harold dump to copper smelters in the Salt Lake Valley area; 56,587 tons of such material were shipped in 1944 to copper smelters at Garfield and Tooele compared with 71,779 tons in 1943. The material contained about 3 percent lead, in addition to the gold and silver. The Tintic Standard Mining Co. received a flat price per ton for material sold from the dump.

During 1944 the North Lily Mining Co., on its own account, conducted as active a program of mining and development as the shortage of manpower would permit, operating the North Lily mine, Tintic Bullion lease, and Eureka Bullion lease. The most productive property was the Tintic Bullion lease, from which the output was 6,344 tons of rich gold ore and 425 tons of zinc-lead ore, all shipped to various reduction plants of the International Smelting & Refining Co. at Tooele. It was followed by the Eureka Bullion lease, which yielded 4,820 tons of gold-silver ore shipped to the Tooele copper smelter. The output from the North Lily mine was 697 tons of gold-silver ore shipped to the Tooele copper smelter. The total development completed by the North Lily Mining Co. in 1944 comprised 4,845 linear feet of drifts, crosscuts, and raises and 4,453 feet of diamond drilling. Other production in the Tintic district, Utah County section, in 1944 included gold-silver ore from the May Day mine, Utah Con group, and Homansville Mill tailings dump and silver ore from the Zuma mine, all shipped to smelters.

MILLARD COUNTY

Notch Peak district.—The Kanosh Leasing Co. operated the "M & M" mine for about 3 months—September through November 1944. During the period of operation 112 tons of oxidized zinc ore assaying over 25 percent zinc were shipped to the Tooele slag-fuming plant; the ore was fumed at Tooele without previous smelting in the lead blast furnace. Production at the mine was limited by fuming-plant requirements.

PIUTE COUNTY

Mount Baldy district.—Gold ore (82 tons) and lead ore (99 tons) from the Deer Trail mine, shipped to a smelter by Sierra Nevada Ltd., and gold-silver ore (86 tons) from the Deer Trail dump, shipped to a

smelter by a lessee, comprised the output from the Mount Baldy district in 1944.

Ohio district.—The bulk of the output from the Ohio district was zinc-lead ore from the Cascade mine, shipped to the Midvale concentrator in 1944 by Floyd Moore. The property was operated from May 1 to November 1. Other production in the district was gold ore from the Shamrock mine and lead ore from the Bully Boy mine, all shipped to smelters.

SALT LAKE COUNTY

Big and Little Cottonwood districts.—Zinc-lead ore shipped to smelters from the Cardiff mine and lead ore from the Tanner's Flat mine comprised the output from the Big Cottonwood district in 1944.

Alta United Mines Co. operated its South Hecla property in the Little Cottonwood district throughout the year. Development was confined to the Dwyer drain and transportation tunnel of the South Hecla mine, but operations were limited because of lack of miners; however, considerable repair and rehabilitation work was done to surface structures and in the timbered areas of the mine. Test shipments of ore were made from four separate places in the mine and totaled 202 tons of ore containing 21 ounces of gold, 7,642 ounces of silver, 9,915 pounds of copper, 5,549 pounds of lead, 3,866 pounds of antimony, and 7,591 pounds of bismuth; the ore also contained some tungsten which was not saved.

The Bureau of Mines did considerable development in the district during 1944, most of which was confined to the properties of the Alta United Mines Co. Other production in the district came from the Columbus mine.

Smelter district.—All the output credited to the Smelter district in 1944 was material shipped to smelters from slag dumps, various assay office clean-ups, and railroad yards.

West Mountain (Bingham) district.—The Bingham district, by far the most important mining area in Utah, produced 91 percent of the gold, 62 percent of the silver, virtually all of the copper, 59 percent of the lead, and 49 percent of the zinc output of the State in 1944. The total value of the metal output declined 10 percent from 1943 but again surpassed that of any other district in the United States by a wide margin. The value of the total production in the district from 1865 to 1944 is exceeded only by the all-time production of the Butte district in Montana. The following table shows production from mines in the Bingham district in 1943 and 1944 and the total from 1865 to 1944.

Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Salt Lake County, Utah, 1943-44, and total, 1865-1944, in terms of recovered metals

Year	Mines producing	Ore (short tons)	Gold (lode and placer) (fine ounces)	Silver (lode and placer) (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
1943.....	14	36,532,301	343,551	5,404,365	644,495,100	70,873,600	46,809,500	\$110,022,698
1944.....	11	30,344,838	312,493	4,671,478	562,199,000	62,337,300	38,302,000	99,509,472
Total, 1865-1944..	.....	(1)	5,454,229	137,466,112	² 4,333,954	² 1,526,963	² 457,434	1,675,965,677

¹ Figures not available.

² Short tons.

Because of circumstances beyond its control, the Utah Copper Co. in 1944 did not equal its record rate of production established in 1943; however, the company remained the leading world producer of copper. The company produced virtually all the State output of copper and as a byproduct made an important contribution to Utah's gold and silver output. An acute shortage of skilled and unskilled labor, which became more severe as the year progressed, prevented continuation of maximum production from the open-pit operations of the company at Bingham. Every effort was made to obtain Mexican workmen for surface employment at the company's Utah property, but without success. A few Puerto Rican workmen, however, were employed with some success at the open-pit operations. In 1944 ore and waste were mined at the rate of approximately 170,000 tons a day compared with 218,000 tons in 1943. The practice of piling the waste rock in gulches adjacent to the pit was continued. Ore was milled at the Arthur and Magna plants at the rate of about 80,000 tons a day compared with 97,000 tons in 1943; the plants were shut down 4 days during the year because of a failure of the tailings dike. The average grade of the ore treated was about the same as that in 1943. Average mill recoveries in 1944 were slightly higher than in 1943. The new power plant, in process of construction during 1943, was completed in February 1944.

The printed annual report of the Kennecott Copper Corp. for the year ended December 31, 1944, says that the most important event at the Utah unit was the starting of power generation in February at the new Central power plant. The 50,000-kw. steam turbo-generator unit now installed has been furnishing all the power required for milling the reduced tonnages prevailing since May. The mine has continued to operate on purchased power. When conditions permit, it is understood that additional generating equipment sufficient to provide Utah's (unit) full requirements of power may be added.

Breaks in the dikes enclosing the tailings have twice been a source of stoppages in milling operations. The company report states that extensive work was done on the dikes enclosing the 6,000-acre tailings-impounding pond. For the past 3 years breaks in the dikes, which have now reached a considerable height, have been a source of trouble and in August 1944 caused a complete suspension of milling operations for 4 days. Two years ago an inner protecting dike, about 150 feet inside the pond, was constructed along the north side, and as no breaks have since occurred in the north side an inner dike appears to be the solution of these difficulties. This same system of inner reinforcements is now being provided on the east, south, and west sides of the pond; the work was more than half completed at the end of 1944.

In addition to the great quantity of copper contained in the copper concentrates made at Arthur and Magna, the company, by forced leaching of its waste dumps, produced copper precipitates in 1944 which contained about 36,000,000 pounds of copper, a gain of about 8,000,000 pounds compared with 1943. This was the largest yearly output of copper precipitates on record. The precipitating plant is at Lead Mine in the mouth of Bingham Canyon.

In December 1943 the company began driving an 18- by 24-foot transportation adit, 4,600 feet in length, which is large enough to accommodate a standard locomotive. The adit was started at the lower end of the town of Bingham and will end under the present floor of

the open pit. When 1944 closed, 3,900 feet of the proposed 4,600 had been driven, and concrete lining had been placed where heavy ground was encountered. After driving is completed, 3,800 feet of the tunnel will be lined with concrete, and it is expected that the work will be completed by the middle of 1945.

The Boston Consolidated mine, owned by the Utah Copper Co., was operated under lease all of 1944 by the American Smelting & Refining Co. The tonnage of copper ore mined and shipped to the Garfield smelter amounted to about half of that mined in 1943, and the grade of the ore mined was much lower than in 1943.

The chief source of zinc and lead production in the Bingham district continued to be the United States & Lark property operated by the United States Smelting, Refining & Mining Co. The district production of lead and zinc in 1944 declined about 8,500,000 pounds each, the direct result of a similar decline in output at the United States & Lark property. The company mined and shipped about 62,000 tons less zinc-lead ore to its Midvale concentrator than in 1943; the metal content of the ore was slightly higher in silver and copper content but about the same in gold, lead, and zinc. In addition to the zinc-lead milling ore, the company shipped a total of about 17,000 tons of gold ore, lead ore, and zinc-lead ore to smelters. The mine retained its position as the leading lead producer and second-largest zinc producer in the Western States, and it also produced substantial quantities of gold, silver, and copper. Development was about the same as in 1943 and involved the completion of 254 feet of shaft, 19,387 feet of raises and drifts, and 2,802 feet of diamond drilling. Other properties in the Bingham district owned or controlled by the United States Smelting, Refining & Mining Co. and active in 1944 included the Montana-Bingham Consolidated and Niagara. Production in 1944 from these two properties comprised 12,865 tons of zinc-lead milling ore treated at the Midvale concentrator and 1,438 tons of gold-silver ore shipped to a smelter. The company printed annual report for the year ended December 31, 1944, states that operations of the mines at Bingham and the flotation mill and smelter at Midvale were continuous throughout the year. Output was lower by reason of the growing manpower shortage; the grade of ores mined was about the same as in 1943. All the lead bullion produced at the smelter was treated at the electrolytic lead refinery at East Chicago, Ill.

The Apex-Delaware group of properties was operated continuously in 1944 by the National Tunnel & Mines Co. on both company and lease account. The properties are developed through the 5-mile Elton tunnel, the portal of which is a short distance from the reduction plants of the International Smelting & Refining Co. near Tooele, Utah. The following operational details are given by the company printed annual report for the year ended December 31, 1944: Shortage of manpower prevented capacity operations during 1944. This condition became steadily worse throughout the year, resulting in a decrease of almost 50 percent in number of employees at the end of the year. As a result, production of ore declined; however, output of copper, silver, and gold increased slightly because the grade of ore was better than in 1943. Production in 1944 comprised 152,370 tons of copper ore treated at the Tooele copper concentrator, 6,840 tons of zinc-lead ore treated at the Tooele zinc-lead concentrator, and 93 tons of zinc-lead ore shipped to the Tooele lead blast furnace.

During the year development, curtailed on account of the shortage of labor, amounted to the completion of 4,294 feet of crosscuts and raises and 5,169 feet of diamond drilling. A crosscut was driven on the 2,700-foot level from the Rood shaft to explore the Alphabetical lime beds. The "A" bed was reached and showed some mineralization but no commercial ore. Some diamond drilling was done below the 3,300 level in the Yampa lime.

The company enlarged its holdings in the Bingham district during the year by a merger with the Utah Metal & Tunnel Co., owner of adjoining mining property.

In 1944 the Ohio Copper Co. operated a 1,500-ton flotation plant at Lark (Utah) for the treatment of old tailings accumulated from former milling operations, a leaching plant for recovery of copper from old mine stopes in mining ground formerly owned by the company under a royalty agreement with the present owners, and a small underground electric railway which served the Ohio Copper Co. and an adjoining mine of the United States Smelting, Refining & Mining Co. Although 493,413 tons of material were treated, compared with 469,747 tons in 1943, the output of copper was smaller, owing to a decline in grade of material treated; that treated in 1944 contained about 7.7 pounds of gross copper per ton. The company also produced 295 tons of copper precipitates by leaching. At the beginning of operations at the Columbia group in 1937 the Ohio Copper Co. estimated that 5,000,000 tons of tailings were available for re-treatment. By the end of 1944 2,680,000 tons had been processed, theoretically leaving 2,320,000 tons still available for treatment. However, according to the company printed annual report for the year ended December 31, 1944, all of this total cannot be reclaimed. Owing to location, the remaining tonnage will present more difficult reclamation problems; in addition, the copper content of the material left is lower than of that treated in past years.

The Butterfield group, including the Queen property, was operated throughout 1944 by the Combined Metals Reduction Co. and lessees. A total of 25,905 tons of zinc-lead ore was shipped to the Bauer mill of the company, and 316 tons of ore of all classes were shipped to smelters. The output was somewhat less than in 1943.

Other production in the Bingham district included zinc-lead mill ore from the New England mine and crude ore of several classes from the Kaign and Bingham Congor properties, all shipped to smelters.

SAN JUAN COUNTY

La Sal district.—Late in 1943 the Ohio Copper Co. completed the construction and equipment of a leaching plant with a daily capacity of 250 tons at its Big Indian property 6 miles south of La Sal. The production of copper from the plant was under contract to the Metals Reserve Company, but early in 1944 the War Production Board diverted the supply of acid relied on and absolutely essential to the leaching method of operation. The Ohio Copper Co. states in its annual report for the year ended December 31, 1944, that it had a large investment in a property dependent on an acid-leach process, but no acid was available; consequently, it turned to concentration by flotation. Although the treatment of oxidized copper ore by flotation has never been particularly successful, the company after

laboratory tests adopted a new technique that had indicated a satisfactory recovery of the metal values. To determine further the feasibility of this type of operation, sufficient equipment was installed at the Big Indian plant to permit the treatment of 40 to 50 tons of copper ore daily by this new flotation process.

After 4 months of operation results warranted increasing the flotation capacity to 250 tons of ore a day. Sufficient equipment had been installed by the end of 1944 to permit operation at the rate of 175 tons a day; early in 1945 the full 250-ton capacity is expected to be reached. During 1944, 8,009 tons of copper ore containing 397,246 pounds of copper were treated, making 528 tons of copper concentrates which contained 275,848 pounds of copper, indicating a copper recovery of 69 percent.

SUMMIT AND WASATCH COUNTIES

PARK CITY REGION

The Park City region includes the Uintah district in Summit County and the Blue Ledge and Snake Creek districts in Wasatch County. Mines in the Park City region, severely handicapped by acute shortages of labor, produced a smaller quantity of all metals than in 1943. The region continued to supply large quantities of tailings to smelters to be used for flux and also reconcentrated for zinc and lead. The following table shows the production and total value of all metals in 1944 compared with 1943 and the total from 1870 to 1944.

Mine production of gold, silver, copper, lead, and zinc in Park City region, Summit and Wasatch Counties, Utah, 1943-44, and total, 1870-1944, in terms of recovered metals

Year	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
1943	15	362,950	19,559	2,001,555	1,265,100	32,044,200	22,973,000	\$7,156,755
1944	8	203,001	15,149	1,429,650	956,800	23,319,600	19,111,000	5,720,245
Total, 1870-1944	(1)		531,028	232,731,448	67,004,113	2,373,867,431	653,188,611	357,077,148

¹ Figures not available.

The total tonnage of ore mined and treated by the Silver King Coalition Mines Co. in its 800-ton flotation mill was 54,252 tons compared with 95,800 tons in 1943, a decrease of 43 percent. Labor shortage and operational difficulties handicapped both mining and development to a considerable extent in 1944.

The Quota Committee of the Premium Price Plan for Copper, Lead, and Zinc adjusted the company quotas effective June 1, and although it was granted zero quota and a 5-cent premium for copper, zero quota and the A and B premium (2½ cents a pound for each premium) for lead, and zero quota and A, B, and C premium for zinc, the company ended the year 1944 with a net profit of \$6,870 after all costs and depreciation (\$24,414) had been deducted. The mine was operated 305 days, but the 800-ton concentrator worked only 104 days on a three-shift basis because of the low production of ore. The company printed annual report for the year ended December 31, 1944, says that mining and milling operations at the Park City property were carried

on continuously throughout 1944. Effective June 12, underground operations were converted from two shifts to one shift per day in order to place a larger portion of the available manpower on extraction and development. The labor shortage within this area has been aggravated since that date so that at the present time 65 additional men are required for efficient operations on one shift. The monthly average of man-shifts worked per day dropped from 372 to 246 from January to December. The 54,252 tons of zinc-lead ore milled made 5,189 tons of lead concentrates and 2,729 tons of zinc concentrates; the total metal content of the concentrates was 537 ounces of gold, 428,239 ounces of silver, 207,890 pounds of copper, 7,042,100 pounds of lead, and 3,418,499 pounds of zinc. The lead concentrates averaged 67.1 percent lead and were shipped to the Murray smelter, and the zinc concentrates averaged 61.8 percent zinc and were shipped to the Anaconda Copper Mining Co. zinc smelter at Anaconda. In addition, 236 tons of silver-lead ore containing 14 ounces of gold, 14,814 ounces of silver, 4,605 pounds of copper, and 218,756 pounds of lead were shipped to the Murray smelter.

Total development footage completed during the year included 11,802 feet of drifts, 1,496 feet of raises, and 246 feet of winzes. On September 28, development on the 1,960 level struck a large flow of water and the pumps on the 1,900 level were drowned; the workings of the West End and 5,141 Section of the mine were flooded. Pumps were installed, and by December 29 the water had been lowered to the 1,900 level. Additional pump stations have been cut on the 1,700 and 1,900 levels, and new pumps and pipe lines were being installed during the first part of 1945. Development on the 1,960 level opened up the continuation of one of the West End ore bodies. The small amount of development done after encountering the ore and before the inundation makes impossible any reliable estimate of the extent of this body. The ore where opened is high-grade silver-lead with low zinc.

In 1944 the Park Utah Consolidated Mining Co. operated its Park Utah Consolidated mines group in Summit County and its Park Utah Consolidated group in Wasatch County and produced 38,986 tons of ore, of which 32,146 tons came from Summit County and 6,840 tons from Wasatch County. The extensive unwatering and development program started in 1943 had reached its first objectives early in 1944. The new ore opened was of good grade and added much to the total metal output of the company. All the ore mined and shipped during 1944 went to the various reduction plants of the International Smelting & Refining Co. at Tooele and comprised 38,310 tons of zinc-lead mill ore, 460 tons of lead smelting ore, and 216 tons of zinc-lead smelting ore. The zinc-lead ore from this property is very amenable to flotation, and as a result the recoveries obtained are among the highest in the State. The 38,986 tons of ore mined and shipped contained 823 ounces of gold, 556,511 ounces of silver, 316,317 pounds of copper, 9,493,412 pounds of lead, and 9,628,150 pounds of zinc. This tonnage represents a decrease of more than 20 percent from 1943, but the average grade was higher.

The company printed annual report for the year ended December 31, 1944, says that the output of the company and the prosecution of development operations have been seriously handicapped by war conditions, of which the shortage in manpower was the primary factor. During the year the pay roll averaged 290 men, compared

with 344 in 1943 when a deficiency in labor already existed. In June 1944 the shortage became so acute that two-shift operation was replaced by single-shift. During the remainder of the year the labor supply deteriorated further. Development completed during the year consisted of 14,586 feet of drifting, raising, and crosscutting and 4,325 feet of diamond drilling.

The New Park Mining Co. mined and shipped to the Midvale concentrator 57,640 tons of zinc-lead ore in 1944 compared with 55,811 tons in 1943. The decline in tonnage was attributed to the prevailing shortage of manpower. The company was the leading producer of gold, copper, and lead in the Park City region. The gold-silver-copper-lead-zinc ore mined in 1944 contained 15,186 ounces of gold, 449,930 ounces of silver, 719,317 pounds of copper, 8,005,803 pounds of lead, and 10,732,276 pounds of zinc and when compared with the ore mined in 1943 indicates a decline in gold, silver, and copper content but an increase in lead and zinc content. Development completed in 1944 comprised 2,870 feet of crosscuts and drifts, 1,118 feet of raises, 147 feet of shaft, and 4,162 feet of diamond drilling; the company also completed 478 feet of development in the Star of Utah tunnel.

The company in its printed annual report for the year ended December 31, 1944, states with regard to development for the year: In order to keep the right ratio of development work to extraction of ore it is necessary to keep reserves blocked out far enough ahead of production to permit efficient planning and operating. The shortage of labor has thrown this ratio out of balance and to correct this the company has contracted for a program of diamond drilling. The results have been successful in locating two new ore bodies. The first is a 10-foot fissure 460 feet north of the main ore body, known as the Pearl fissure; the company is now crosscutting to open it up from the 1,020 level. The second is in the Mayflower-Galena fissure over 1,000 feet west of the main ore body; this fissure is wide and the ore, although rather low-grade where cut, is improving with development. These two ore bodies should add considerably to the company ore reserves. Work was resumed in the Star tunnel, where the company intends to follow the ore opened near the Mariam claims to the projected junction with the large fissure on those claims, which is believed to be the westward extension of the Mayflower-Galena fissure. The company is sinking the main shaft to open up additional levels to keep development well ahead of extraction of ore.

A small flotation mill on Silver Creek just below the Silver King Coalition Mines Co. 800-ton flotation mill is used by Rueben Garbett to re-treat the current tailings from the Silver King Coalition mill. In 1944 about 46,000 tons of such tailings were treated, producing 552 tons of zinc middlings which were shipped to the Midvale concentrator for further treatment.

A total of 5,011 tons of old tailings from various claims on Silver Creek were shipped to smelters and concentrating mills, principally the Garfield smelter. The tailings contained a small quantity of lead, zinc, and silver and were shipped only because of Quota Committee premiums. These tailings were one source of siliceous material available with a very small expenditure of manpower. Usually they are used at copper smelters as reverberatory flux.

Other production in the Park City region included zinc-lead and silver ore from the Park Flag mine (formerly American Flag) and zinc-lead ore from the New Quincy mine.

TOOELE COUNTY

Tooele County continued in 1944 to rank fourth among the metal-producing areas in Utah. Mines in the county produced gold, silver, copper, lead, and zinc valued at \$2,542,218 compared with \$3,243,258 in 1943.

Camp Floyd district.—Crude siliceous gold and gold-silver ore from the Geyser Marion group and Sacramento properties, shipped to the Garfield smelter, comprised the output from the Camp Floyd district in 1944. These properties were granted an exception to the gold-mine closing order so as to supply siliceous ore to copper smelters for fluxing. The Sacramento was operated under lease by Charles Mercer, and the Geyser Marion group was operated until November 7 by the Geyser Marion Co. and thereafter by A. J. Kirkman under lease agreement.

Clifton district.—The Gold Hill arsenic mine was operated under lease in 1944 by the United States Smelting, Refining & Mining Co. The principal output was arsenic ore from which some gold-silver ore was derived as a byproduct. The property was closed in January 1945, after the known ore bodies were exhausted.

Dugway district.—The Rip Van Winkle Consolidated Mining Co. began operation of its Smelter Canyon mine September 13 and continued the rest of the year. Production included 593 tons of zinc-lead ore and 50 tons of silver ore shipped to the Tooele smelter and 305 tons of zinc-lead milling ore shipped to the International sulfide concentrator and Combined Metals mill at Bauer. A small lot of gold ore was shipped to a smelter from the Final Success mine.

Lakeside district.—The Monarch mine was operated by the Lakeside Monarch Mining Co. for 6 months in 1944 and produced 680 tons of lead ore shipped to the smelter at Murray.

North Tintic district.—The output from the North Tintic district in 1944 consisted of 30 tons of zinc ore from the dump of the Scranton mine and was shipped to the Tooele slag-fuming plant.

Ophir district.—The Hidden Treasure mine, operated by the United States Smelting, Refining & Mining Co. from January 1 to May 31, 1944, was the chief producer in the Ophir district during the year; output was 1,458 tons of ore of several classes shipped to smelters and 133 tons of zinc-lead-copper mill ore shipped to the Midvale concentrator. The Ophir Development Co. operated its Ophir Hill property throughout 1944 and produced 772 tons of ore (all classes) which was shipped to smelters and 401 tons of zinc-lead ore which was shipped to the Tooele sulfide concentrator; the company also produced 400 tons of ore of several classes from the Montana Lease, an adjoining property. Other producers in the district included the Kearsarge group of properties, Shoo Fly group, Togo claim, and Wandering Jew mine.

Rush Valley district.—The West Calumet (Calumet) mine operated by the Combined Metals Reduction Co. was one of the principal producers of zinc and lead in the State during 1944 and was operated on both company and lessee account. Production consisted of 40,311

tons of zinc-lead ore which was treated at the Bauer mill and 147 tons of lead ore which was shipped to the Tooele lead smelter. A greater output could not be attained at this property during 1944 because of the prevailing labor shortage. Other production in the district included ore of several classes shipped to smelters from the Honerine-Galena King group by the Combined Metals Reduction Co., the Bluestone group, Ben Harrison mine, and the Blue Eagle mine. Milling ore from the Honerine-Galena King (zinc-lead) and Bluestone (lead) properties was shipped to the Bauer mill and Tooele sulfide concentrator, respectively.

Smelter district.—Again in 1944, the second-largest source of zinc in Utah was zinc slag fumed at the International Smelting & Refining Co. plant at Tooele. The plant was operated continuously throughout the year and fumed a total of 133,378 tons of hot slag, cold slag, and crude ore. The production from the operation was a zinc-lead fume which was treated further to separate the zinc fume from the lead fume. The zinc fume averaged 72.3 percent zinc and was shipped to the International Minerals & Metals Corp., Bartlesville, Okla.; the lead fume averaged 42.8 percent lead and was re-treated at the Tooele lead blast furnace. Although the plant treated 133,378 tons of material, only the metals recovered from the fuming of 48,880 tons of old zinc slag are credited to the slag-fuming plant as a prime producer and to the "Smelter district." The remainder comprised metals obtained from current slag derived from the smelting of ores and concentrates from mines in Utah and other States and from ore fumed directly, and these metals are credited to those mines. The recovery of zinc at the slag-fuming plant was higher than in 1943. The recovery of lead from ores treated in the lead blast-furnace-slag-fuming-plant circuit is exceptionally high, and ultimate loss of lead in the discarded slag in the fuming plant is very small.

Willow Springs district.—The Oro Del Rey mine was operated in 1944 on lessee account; 354 tons of lead ore containing considerable gold were shipped to smelters.

UTAH COUNTY

American Fork district.—The output from mines in the American Fork district in 1944 was zinc-lead ore shipped to various concentrating plants in the Salt Lake Valley. The Golden West Consolidated Mining & Leasing Co. operated its Dutchman group from January 1 through November 24 and shipped 676 tons of ore to the Bauer concentrator and Midvale concentrator. The Howell Mining Co. operated its Globe mine from April 15 to December 31 and shipped 340 tons of ore to the Tooele sulfide concentrator.

Tintic district.—Mines in the Utah County section of the Tintic district are reviewed under Juab County.

WASHINGTON COUNTY

Tutsagubet district.—James J. Smith and Emerald L. Coz began operating the Dixie mine in the Tutsagubet district on June 23 and continued to the end of the year. Production amounted to 596 tons of oxidized copper ore, which was shipped to the Garfield smelter.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON

(MINE REPORT)

By G. E. WOODWARD AND PAUL LUFF

SUMMARY OUTLINE

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SUMMARY

Mines in Washington yielded gold, silver, copper, lead, and zinc valued, in terms of recoverable metals, at \$7,195,136 in 1944 compared with \$7,838,012 in 1943. The average prices paid for copper, lead, and zinc were higher than in 1943, which tended to maintain total value of metal output near the 1943 level despite a decline in output of each metal except lead; however, the total value was the lowest since the United States entered the present war. The output of lead exceeded that in any other year. The decrease in gold and silver resulted from a decline in production from the two leading gold and silver producers in the State—the Howe Sound Co., operating the Holden property in Chelan County, and Knob Hill Mines, Inc., operating its gold property in Ferry County. The Holden property was again the principal source of copper, and although the company treated a larger tonnage of ore in 1944 than in 1943 the gold, silver, copper, lead, and zinc content was less. The decreased production of zinc and the increased production of lead in Washington were the net result of treating a smaller tonnage of zinc-lead ore from the mines in Pend Oreille County having about the same zinc but a higher lead content than in 1943. The Pend Oreille Mines & Metals Co. was the principal zinc producer in the State, and the American Zinc, Lead & Smelting Co. was the largest lead producer.

Shortages of labor continued to be the chief deterrent to a greater output of base metals throughout the State. In 1942 and again in 1943 the Army furloughed soldiers for service in the mines, but no such help was forthcoming during 1944. Development to increase the current output of metals and develop new ore bodies was greatly curtailed. The Holden mine, largest metal mine in the State, closed the year with 38 percent fewer men working underground than at the beginning of the year. On July 1, 1944, the War Production Board and War Manpower Commission jointly sponsored a system whereby mines producing critical metals would receive a labor priority. The priority gave the mines a preference in the labor market both locally

and nationally; some help, although inadequate, was obtained from the use of this system. The premium price plan, inaugurated in 1942, was continued throughout 1944.

The Geological Survey and Bureau of Mines remained active during 1944 in aiding producers of critical metals from several properties in Washington. The diamond drilling of large mineralized areas in the Metaline district of Pend Oreille County by the Bureau of Mines was continued, with the result that the probable reserves of zinc-lead ore were increased substantially.

The Department of Agriculture, operating through the Forest Service, continued to administer the access-road program.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ³	Zinc ³
	<i>Per fine ounce</i>	<i>Per fine ounce</i>	<i>Per pound</i>	<i>Per pound</i>	<i>Per pound</i>
1940	\$35.00	\$0.711+	\$0.113	\$0.050	\$0.093
1941	35.00	.711+	.118	.057	.075
1942	35.00	.711+	.121	.067	.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price reflects bonus payments by Metals Reserve Co. for overquota production.

* \$0.71111111.

Mine production of gold, silver, copper, lead, and zinc in Washington, 1940-44, and total, 1860-1944, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1940	83	88	1,166,798	82,136	\$2,874,760	365,175	\$259,680
1941	61	56	1,238,509	84,176	2,946,160	402,030	285,888
1942	37	18	1,222,937	75,396	2,638,800	369,038	262,427
1943	24	2	1,131,281	65,244	2,283,540	370,440	263,424
1944	25	3	1,180,662	47,277	1,654,695	321,608	228,699
1940-1944			(1)	2,069,642	51,192,793	12,283,976	8,695,697

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1940	19,224,000	\$2,172,312	5,110,000	\$255,500	23,120,000	\$1,456,560	\$7,018,812
1941	17,372,000	2,049,896	7,806,000	444,942	28,640,000	2,148,000	7,874,886
1942	16,060,000	1,943,260	9,702,000	650,034	28,796,000	2,678,028	8,172,609
1943	14,630,000	1,901,900	10,044,000	753,300	24,406,000	2,635,848	7,838,012
1944	12,338,000	1,665,630	11,650,000	932,000	23,808,000	2,714,112	7,195,136
1940-1944	* 68,578	17,662,091	* 68,974	8,841,914	* 114,793	16,924,982	103,317,477

¹ 1940-1903: Figures not available; 1904-44: 10,699,153 tons produced.

* Short tons.

Gold and silver produced at placer mines in Washington, 1940-44, in terms of recovered metals

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1940.....	2,747	\$96,145	720	\$512	\$96,657
1941.....	540	18,900	90	64	18,964
1942.....	356	12,460	59	42	12,502
1943.....	116	4,060	17	12	4,072
1944.....	59	2,065	7	5	2,070

Gold.—The output of recoverable gold from lode and placer operations in Washington in 1944 was 47,277 fine ounces, a 28-percent decrease from 1943. Only two mines producing gold in substantial quantities from siliceous ores remained active in 1944; all others were closed. The decrease in output of gold in the State was the result of marked declines in output at its two largest gold producers, namely, the Howe Sound Co. and Knob Hill Mines, Inc. The greater decrease was noted at the Holden property of the Howe Sound Co., where a larger tonnage of ore was mined and treated than in 1943 but of a much lower gold content; most of the ore was mined from ore bodies low in gold content while the new extraction shaft below the main haulage tunnel was being completed. Although Knob Hill Mines, Inc., treated ore with a slightly higher gold content, the tonnage treated in 1944 was sufficiently smaller than that treated in 1943 to show a net decrease in gold output. Ores of the Holden mine, valued also for their copper and zinc content, continued to be the chief source of gold in the State and in 1944 yielded 55 percent of the State total; it was followed by Knob Hill Mines, Inc., which treated gold ore throughout the year from its Knob Hill mine by cyanidation and concentration. These two properties, long producing most of the State output of gold, contributed over 94 percent of the total in 1944. Among other gold-producing properties were the Aurum mine in the Republic district of Ferry County and the Blue Ridge property of the Sierra Zinc Co. in the Northport district of Stevens County.

The total output of siliceous ore was 62,063 tons, principally gold ore, compared with 61,220 tons, virtually all gold ore, in 1943; it was treated as follows: 42,245 tons by combination cyanidation and concentration, 200 tons by straight concentration, and 19,618 tons shipped crude to smelters. Placers yielded 59 ounces of gold.

Silver.—The output of recoverable silver in Washington was 321,608 fine ounces in 1944, compared with 370,440 ounces in 1943; all the silver recovered was a byproduct of gold or base metals. Losses in output from mines in Benton, Chelan, Ferry, Snohomish, and Whatcom Counties more than offset gains from mines in Okanogan, Pend Oreille, and Stevens Counties. Virtually the entire State output of silver came from mines in Chelan, Ferry, Okanogan, Pend Oreille, and Stevens Counties. Mines in Chelan and Ferry Counties, for years the chief source of silver, yielded 73 percent of the State total in 1944. Gold ore yielded 40 percent of the total State silver; zinc-copper ore, 32 percent; zinc-lead and zinc ores, 26 percent; and gold-silver, silver, copper, and lead ores and placers, the remainder. The Knob Hill mine

of Knob Hill Mines, Inc., in Ferry County was again the largest silver producer in the State; it was followed by the Holden property of the Howe Sound Co. in Chelan County, the Kaaba property of the Kaaba-Texas Mining Co. in Okanogan County, and the Aurum group of properties in Ferry County; these four properties contributed 88 percent of the State total silver. Placers yielded 7 ounces of silver.

Copper.—The output of recoverable copper in Washington in 1944 was 12,338,000 pounds, or 16 percent less than in 1943. As in former years, virtually the entire State output of copper was recovered from the zinc-copper ores of the Holden property of the Howe Sound Co. The company shipped copper concentrates rich in gold to the Tacoma smelter and zinc concentrates to the Sullivan electrolytic smelter in Idaho for treatment. The copper concentrates contained nearly all the recoverable gold in the zinc-copper ore. The value of the gold content of the copper concentrates was equivalent to 55 percent of the value of the copper. Following the Howe Sound Co. as copper producers were the Kaaba mine of the Kaaba-Texas Mining Co. in Okanogan County and the Blue Ridge property of the Sierra Zinc Co. in Stevens County.

Lead and zinc.—The production of recoverable zinc in Washington in 1944 declined 598,000 pounds (2 percent) compared with 1943, but the output of recoverable lead exceeded that in any year of the State's history.

Mines in Pend Oreille County produced considerably more lead than in 1943 but a slightly smaller quantity of zinc. Shortages of manpower were again the greatest obstacle to maximum production. The gain in lead output was due principally to a pronounced change in lead content of the zinc-lead ores treated by the American Zinc, Lead & Smelting Co. from the Metaline Mining & Leasing Co. property; the decrease in zinc was due directly to a smaller output from the Pend Oreille Mines & Metals Co., which treated less zinc-lead ore than in 1943, but of about the same grade. Zinc-lead ore treated in 1944 in two flotation mills (Pend Oreille and Grandview) totaled 305,516 tons, compared with 311,245 tons in 1943. The ore averaged 2.08 percent in lead and 3.88 percent in zinc, compared with 1.70 and 3.80 percent, respectively, in 1943.

The Sierra Zinc Co. operated its Blue Ridge property in Stevens County until September 1, 1944, and was the fourth-largest producer of zinc in the State. The Howe Sound Co. recovered zinc from its zinc-copper ore and ranked fifth as a source of zinc; the output declined 44 percent from 1943. Most of the remaining lead and zinc produced was recovered from mines in Okanogan and Stevens Counties. Zinc and zinc-lead ore treated from mines in Stevens County amounted to 32,559 tons, compared with 21,112 tons in 1943, and zinc-lead ore treated in Okanogan County totaled 23,930 tons compared with 14,431 in 1943. The zinc content of ore treated from mines in Stevens County was the highest in the State.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Washington in 1944, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Benton.....		1	55	\$1,925	7	\$5
Chelan.....	2		26,327	921,445	103,694	73,738
Ferry.....	4		20,479	716,765	132,075	93,920
Kittitas.....		1	3	105		
Okanogan.....	2		26	910	53,100	37,760
Pend Oreille.....	4				15,580	11,079
Snohomish.....	2		4	140	322	229
Stevens.....	11		382	13,370	16,830	11,968
Yakima.....		1	1	35		
Total, 1943.....	25	3	47,277	1,654,695	321,608	228,690
	24	2	65,244	2,283,540	370,440	263,424

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Benton.....							\$1,930
Chelan.....	12,237,800	\$1,652,103	9,000	\$720	2,148,000	\$244,872	2,892,878
Ferry.....							810,685
Kittitas.....							105
Okanogan.....	56,400	7,614	518,000	41,440	167,000	19,038	106,762
Pend Oreille.....			10,555,000	844,400	18,471,000	2,105,694	2,961,173
Snohomish.....	13,800	1,863					2,232
Stevens.....	30,000	4,050	568,000	45,440	3,022,000	344,508	419,336
Yakima.....							35
Total, 1943.....	12,338,000	1,665,630	11,650,000	932,000	23,808,000	2,714,112	7,195,136
	14,630,000	1,901,900	10,044,000	753,300	24,406,000	2,635,848	7,838,012

Gold and silver produced at lode mines in Washington in 1944, by counties, in terms of recovered metals

County	Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)
Chelan.....	757,726	26,327	103,694
Ferry.....	60,168	20,479	132,075
Okanogan.....	23,980	26	53,100
Pend Oreille.....	305,516		15,580
Snohomish.....	36	4	322
Stevens.....	33,236	382	16,830
Total, 1943.....	1,180,662	47,218	321,601
	1,131,281	65,128	370,423

Gold and silver produced at placer mines in Washington in 1944, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Dragline and dry-land dredges ¹		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
Benton.....			55	7	55	7
Kittitas.....	3				3	
Yakima.....	1				1	
Total, 1943.....	4		55	7	59	7
	2		114	17	116	17

¹ A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

MINING INDUSTRY

Seven properties in Washington produced 1,149,693 tons of ore in 1944—97 percent of the State total. This output included zinc-copper ore (64 percent) from the Holden mine in Chelan County; zinc-lead ore from the Pend Oreille, Metaline, and Grandview mines in Pend Oreille County and the Kaaba-Texas property in Okanogan County; zinc ore from the Blue Ridge property in Stevens County; and gold ore from the Knob Hill property in Ferry County.

Development completed on company account in these seven properties in 1944 included 21,464 feet of drifts, raises, and shafts and 41,766 feet of diamond drilling. Although the total footage of development work in 1944 exceeded that in 1943, it was confined mostly to current drifts preparatory to stoping and not to exploration necessary to open higher-grade ore. Aside from development and exploration on company account, the Government, through its agencies particularly the Bureau of Mines, completed several thousand feet of diamond drilling, mostly in the Metaline district of Pend Oreille County.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Washington in 1944, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	5	59,165	20,434	128,471	-----	-----	-----
Dry and siliceous gold-silver ore	1	2,698	200	4,068	-----	-----	-----
Dry and siliceous silver ore	2	200	2	1,826	413	3,673	-----
Copper ore	2	36	4	322	13,800	-----	-----
Lead ore	4	477	-----	569	660	212,531	-----
Zinc ore	4	31,908	377	11,069	28,127	262,956	2,938,000
Zinc-copper ore	1	756,081	26,198	103,275	12,237,800	9,000	2,148,000
Zinc-lead ore	6	330,097	3	72,001	67,200	11,161,840	18,722,000
Total, lode mines	25	1,180,662	47,218	321,601	12,338,000	11,650,000	23,808,000
Total, placers	3	-----	59	7	-----	-----	-----
	28	1,180,662	47,277	321,608	12,338,000	11,650,000	23,808,000
Total, 1944	26	1,131,281	65,244	370,440	14,630,000	10,044,000	24,406,000

METALLURGIC INDUSTRY

Lode mines in Washington produced 1,180,662 tons of ore in 1944, treated as follows: 42,245 tons in a cyanidation-concentration mill, 1,118,318 tons in straight concentration mills, and 20,099 tons shipped crude to smelters.

Cyanidation mills.—The only cyanide mill active in 1944 was, as in 1943, the 400-ton cyanidation-concentration mill of Knob Hill Mines, Inc. It cyanided a total of 38,741 tons of current tailings, from the flotation concentration of 42,245 tons of gold ore, and consumed 69,000 pounds of calcium cyanide, 483,000 pounds of lime, and 9,700 pounds of zinc dust; the operation was continuous throughout 1944.

Concentration mills.—Eight concentration mills in the State treated a total of 1,118,259 tons of ore, as follows: One plant 756,081 tons of zinc-copper ore, four plants 330,097 tons of zinc-lead ore, one plant 31,849 tons of zinc ore, and two plants a total of 232 tons of silver ore and lead ore; in addition, 59 tons of zinc ore were shipped to the Combined Metals Reduction Co. plant at Bauer, Utah, for treatment. The total rated capacity of the eight concentrating mills was 3,600 tons a day, but the average treated was slightly over 3,000 tons.

Mine production of metals in Washington in 1944, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Old tailings, sands, and slimes cyanided	38,741	2,082	11,954			
Concentrates smelted	62,184	42,753	293,116	12,323,847	11,450,570	23,808,000
Ore smelted	20,099	2,383	16,531	14,153	199,430	
Placer		59	7			
Total, 1943		47,277	321,608	12,338,000	11,650,000	23,808,000
		65,244	370,440	14,630,000	10,044,000	24,406,000

Mine production of metals from cyanidation¹ mills (with or without concentration equipment) in Washington in 1944, by counties, in terms of recovered metals

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal		
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)
Ferry	42,245	2,082	11,954	3,504	16,173	104,594
Total, 1943	42,245	2,082	11,954	3,504	16,173	104,594
	51,135	2,083	10,770	4,153	18,749	152,830

¹ No amalgamation in 1943 or 1944.

Mine production of metals from concentrating mills in Washington in 1944, by counties, in terms of recovered metals

County	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Chelan	756,081	30,020	26,198	103,275	12,237,800	9,000	2,148,000
Okanogan	23,930	614		53,055	50,400	518,000	167,000
Pend Oreille	305,516	24,918		15,580		10,555,000	18,471,000
Stevens	32,791	3,128	382	16,612	29,647	368,570	3,022,000
Total, 1943	1,118,318	58,680	26,580	188,527	12,323,847	11,450,570	23,808,000
	1,069,745	62,312	42,195	194,602	14,598,181	9,830,308	24,406,000

GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON 469

Gross metal content of concentrates produced from ores mined in Washington in 1944, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold.....	3,504	16,173	104,594	12,583,026	103,000	1,836,358
Copper.....	27,656	26,102	102,275	24,738	11,165,108	442,539
Lead.....	7,724	187	24,143	40,341	531,141	21,680
Lead-copper.....	424	291	9,124	93,384	436,891	26,268,599
Zinc.....	22,681	291	9,124	93,384	436,891	26,268,599
Zinc-copper.....	195	195	1,269	23,844	10,005	186,127
Total, 1943.....	62,184	42,753	293,748	12,765,333	12,246,145	28,755,303
	66,465	60,944	352,016	15,081,428	10,568,284	30,369,383

Mine production of metals from Washington concentrates shipped to smelters in 1944, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Celan.....	30,020	26,198	103,275	12,237,800	9,000	2,148,000
Fort.....	3,504	16,173	104,594	12,237,800	9,000	2,148,000
Grain.....	614	187	53,055	56,400	618,000	167,000
Grain & Oreille.....	24,918	15,580	15,580	29,647	10,555,000	18,471,000
Spokane.....	3,128	382	16,612	29,647	368,570	3,022,000
Total, 1943.....	62,184	42,753	293,116	12,323,847	11,450,570	23,808,000
	66,465	60,944	347,432	14,598,181	9,830,308	24,406,000

BY CLASSES OF CONCENTRATES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold.....	3,504	16,173	104,594	12,205,146	103,000	1,836,358
Copper.....	27,656	26,102	102,275	24,738	11,165,108	442,539
Lead.....	7,724	187	24,143	40,341	531,141	21,680
Lead-copper.....	424	291	9,124	93,384	436,891	26,268,599
Zinc.....	22,681	291	9,124	93,384	436,891	26,268,599
Zinc-copper.....	195	195	1,269	23,844	10,005	186,127
Total, 1943.....	62,184	42,753	293,116	12,323,847	11,450,570	23,808,000

Gross metal content of Washington crude ore shipped to smelters in 1944, by classes of ore

Class of ore	Ore (short tons)	Gross metal content			
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Dry and siliceous gold.....	16,920	2,179	11,923	1,149	-----
Dry and siliceous gold-silver.....	2,898	200	4,068	14,364	203,309
Copper.....	36	4	322	693	-----
Lead.....	445	-----	218	-----	-----
Total, 1943.....	20,099	2,383	16,531	16,206	203,309
	10,401	2,101	12,221	34,244	222,628

Mine production of metals from Washington crude ore shipped to smelters in 1944, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Chelan.....	1,645	129	419	-----	-----
Ferry.....	17,923	2,224	15,527	-----	-----
Okanogan.....	50	26	45	-----	-----
Snohomish.....	36	4	322	13,800	-----
Stevens.....	445	-----	218	353	199,430
	20,099	2,383	16,531	14,153	199,430
Total, 1943.....	10,461	2,101	12,221	31,819	213,692

BY CLASSES OF ORE

Dry and siliceous gold.....	16,920	2,179	11,923	-----	-----
Dry and siliceous gold-silver.....	2,698	260	4,068	-----	-----
Copper.....	36	4	322	13,800	-----
Lead.....	445	-----	218	353	199,430
	20,099	2,383	16,531	14,153	199,430

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Washington in 1944, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (lode and placer) (fine ounces)	Silver (lode and placer) (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer							
Benton County:									
Columbia River.....		1		55	7	-----	-----	-----	\$1,930
Chelan County:									
Chelan Lake.....	1	-----	756,081	26,198	103,275	12,237,800	9,000	2,148,000	2,888,065
Wenatchee River.....	1	-----	1,645	129	419	-----	-----	-----	4,813
Ferry County:									
Republic.....	4	-----	60,168	20,479	132,075	-----	-----	-----	810,685
Kittitas County:									
Swauk.....		1		3	-----	-----	-----	-----	105
Okanogan County:									
Cascade.....	1	-----	50	26	45	-----	-----	-----	942
Loomis-Oroville.....	1	-----	23,930	-----	53,055	56,400	518,000	167,000	105,820
Pend Oreille County:									
Metaline.....	4	-----	305,516	-----	15,580	-----	10,555,000	18,471,000	2,961,173
Snohomish County:									
Index.....	2	-----	36	4	322	13,800	-----	-----	2,232
Stevens County:									
Bossburg.....	1	-----	24	-----	90	-----	9,900	-----	856
Colville-Middleport.....	3	-----	659	3	1,665	-----	18,900	97,000	13,859
Deer Trail.....	1	-----	1,000	2	3,015	800	73,200	49,000	13,764
Northport.....	6	-----	31,553	377	12,060	29,200	466,000	2,876,000	390,857
Yakima County:									
Naches River.....		1		1	-----	-----	-----	-----	35
Total Washington.....	25		3,180,662	47,277	321,608	12,338,000	11,650,000	23,808,000	7,195,136

BENTON COUNTY

The gold output from Benton County in 1944 came from a dry-land dredge that operated intermittently on Columbia River.

CHELAN COUNTY

Chelan Lake district.—In 1944 the Holden mine of the Howe Sound Co. was again the leading producer of gold and copper and second in silver in Washington, and it was fifth in zinc. The ore treated was 55,521 tons greater than in 1943 but was considerably lower in grade. The smaller gold and silver content contributed materially to the lowering of the State output of gold and silver, and the lower copper content was wholly responsible for the decrease in State copper output. In 1944 the company treated in its 2,000-ton concentrator 756,081 tons of ore, containing an average of 0.048 ounce of gold and 0.98 ounce of silver to the ton, 0.90 percent copper, and 0.37 percent zinc. The mill was operated three shifts a day, six and a half days a week, averaging 2,264 tons a day. The only equipment added to the milling plant in 1944 was a 36-inch jaw crusher, which was installed underground. The shortage of labor at the Holden property was particularly severe in 1944. The Howe Sound Co. states in its printed annual report, dated December 31, 1944, that at the Chelan property the underground force employed during December was 38 percent less than that available at the beginning of the year. The average number of men working in the mine was 25 percent less than during 1943; consequently, the amount of development and exploration that could be done was inadequate.

The new extraction shaft below the main haulage tunnel was not completed until late in the year, and, therefore, the production of ore of copper and gold content equal to that of former years was limited to ore obtained from development. Mining was largely confined to low-grade material occurring above the main haulage tunnel. Under agreement made with the War Production Board, premium payments were received for the copper produced from this source, and the concentrator was operated at greater than rated capacity throughout the year at some profit. Development completed during 1944 comprised sinking 190 feet of shaft, driving 16,091 feet of drifts and raises, and diamond drilling 1,111 feet of holes.

Wenatchee River district.—Knob Hill Mines, Inc., shipped 1,645 tons of gold ore from the Gold King mine to the Tacoma smelter. The ore was shipped to test the value in preparation for further mining.

FERRY COUNTY

Republic district.—Mines in the Republic district were again the main source of siliceous ore in the State. They produced a total of 60,168 tons, of which 42,245 tons were treated by cyanidation-concentration and 17,923 were shipped crude to the Tacoma smelter. Knob Hill Mines, Inc., operated throughout 1944 and continued to be the most important producer in the district and the leading silver and second-largest gold producer in the State. The company treated 42,245 tons of gold ore in its 400-ton combination cyanidation and concentration mill, from which 3,504 tons of concentrates rich in gold were produced and shipped to Tacoma for smelting. The gold bullion was shipped to the Seattle Assay Office. The ore treated in 1944 had about the same gold content as that treated in 1943 but a slightly lower silver content; all production came from underground operations. Development in 1944 amounted to completion of 185 feet of

shaft and 300 feet of drifts. Lessees again operated the Aurum group of properties and shipped 2,269 tons of gold ore and 11,621 tons of dump material to the Tacoma copper smelter. Everett and I. G. Hougland, a partnership, operated the Valley and Republic mines in 1944; the material shipped comprised highly siliceous gold tailings (2,698 tons) from the Republic mine and siliceous gold ore (1,335 tons) from the dump of the Valley mine, and all was shipped crude to the Tacoma copper smelter for flux.

OKANOGAN COUNTY

Cascade district.—A car of gold ore shipped to the Tacoma copper smelter from the Bodie mine comprised the only output from the Cascade district in 1944.

Loomis-Oroville district.—The Kaaba-Texas Mining Co. operated its Kaaba mine and 150-ton flotation mill throughout 1944 and was the only operation producing in the district. The ore treated was slightly lower in grade (averaging 2.3 ounces of silver to the ton, 0.08 percent copper, 1.78 percent lead, and 0.65 percent zinc) than that treated in 1943; however, mill recoveries continued high. Mill machinery, lacking during the first part of 1943, was installed during the latter part of 1943 and in early 1944, permitting operations on a three-shift basis an average of 5 days a week. An average of 75 tons of ore a day was treated during the period of operation in 1944. Development was confined to 14 feet of diamond drilling.

PEND OREILLE COUNTY

Metaline district.—Mines in the Metaline district received much attention during 1944. Several of the major mining corporations operating in western United States showed interest in the potential zinc-lead reserves of the district. Some located tracts of land along the zone of mineralization. The Bureau of Mines, through its program of core drilling, has established a wide area of mineralization, which when developed may justify much larger mining operations than now exist. In 1944 mines in the Metaline district continued to supply the major part of the State output of lead and zinc. The value of recoverable metal was \$2,961,173, compared with \$2,699,363 in 1943. The increase is attributable to a larger output of lead and silver and a higher average price for lead and zinc. The mines were not able to reach capacity output owing to shortage of labor; however, the lead output in 1944 was the highest on record and was due to a higher lead content of the ore treated.

The extensive drilling campaign undertaken in 1943 by the Bureau of Mines on the mineral-bearing areas controlled by the Pend Oreille Mines & Metals Co. and the American Zinc, Lead & Smelting Co. was continued throughout 1944 and was recessed in early January 1945.

The Grandview mine produced 97,543 tons of zinc-lead milling ore, from which 9,716 tons of lead and zinc concentrates were produced. The grade of the ore treated was somewhat higher than in 1943. According to the company printed annual report for the year ended December 31, 1944, development consisted of 7,297 feet of surface diamond drilling, 5,567 feet of underground diamond drilling,

and 1,395 feet of drifts and raises. Production and development were both curtailed as a result of the manpower shortage during the late spring and summer months.

The property of the Metaline Mining & Leasing Co. operated by the American Zinc, Lead & Smelting Co. produced 49,486 tons of zinc-lead ore, from which 4,990 tons of lead and zinc concentrates were produced. The ore treated was considerably higher in lead and slightly higher in zinc content than that treated in 1943; the increased lead content of the ore accounted for the gain over 1943 in total output of lead in both the district and the State. Development on Metaline Mining & Leasing Co. ground in 1944 consisted of 2,620 feet of drifts and 16,523 feet of diamond drilling. The printed annual report of the American Zinc, Lead & Smelting Co. regarding the property states:

During 1944 the Metaline Mining & Leasing Co. retired the first mortgage notes held by the American Zinc, Lead & Smelting Co.

Since the end of 1944 the American Zinc, Lead & Smelting Co. has effected a compromise on all indebtedness and has disposed of all its interest in the property. However, the company will continue to treat ore from the Grandview and Metaline properties in its 600-ton mill.

SNOHOMISH COUNTY

Index district.—Some copper ore was shipped direct to the Tacoma copper smelter from mines in the Index district in 1944.

STEVENS COUNTY

Bossburg district.—Russell Parker operated the Bonanza mine in 1944 until July, when the property was closed. Production amounted to 24 tons of lead ore shipped crude to the Bunker Hill smelter.

Colville-Middleport district.—The Victory Metals Corporation treated silver ore from the Old Dominion mine dump and zinc-lead ore from the Bruce mine in its concentrating mill in 1944. The lead concentrates produced were shipped to the Bunker Hill smelter, and the zinc concentrates went to the Sullivan electrolytic zinc plant. A car of zinc ore from the Northwest zinc mine was shipped to the Bauer (Utah) plant of Combined Metals Reduction Co. for treatment.

Deer Trail district.—Production from the Deer Trail district in 1944 comprised zinc-lead ore from the Cleveland mine milled by Zenith Mines, Inc.

Northport district.—The Sierra Zinc Co. operated its 90-ton flotation mill throughout 1944, treating zinc ore from the company Blue Ridge property during the first 8 months and zinc ore from the Deep Creek mine of the Jamison-Higginbotham Mining Co. during the last 4 months of the year. Production from the Blue Ridge property comprised 22,770 tons of zinc ore, from which 176 tons of lead concentrates and 2,148 tons of zinc concentrates were produced. The ore produced from the Blue Ridge property was slightly higher in grade than that treated in 1943. On February 15, 1944, the Bureau of Mines undertook a drilling campaign on the Blue Ridge property to explore surface indications of ore and concluded it on May 1. Six drill holes having a total length of 1,586 feet were completed. No minable width of ore was encountered in any of the holes; however, these holes provided

structural information useful in planning future drilling or exploration. The Jamison-Higginbotham Mining Co. began operations on July 1 at its Deep Creek mine, 6 miles southeast of Northport. Actual milling of the zinc ore from the property in the Sierra Zinc Co. 90-ton flotation mill was begun on September 1 and continued the remainder of the year. During the period of operation a total of 8,230 tons of ore was treated, from which were produced 550 tons of zinc concentrates averaging about 60 percent zinc and less than 1 percent lead. Other production in the Northport district in 1944 included lead ore shipped to the Bunker Hill smelter from the Gladstone Mountain and Electric Point mines, silver ore concentrated from the Frisco-Standard mine, and lead ore concentrated from the Red Top mine.

YAKIMA COUNTY

Naches River district.—The only production in Yakima County in 1944 was gold recovered from placer property.

GOLD, SILVER, COPPER, AND LEAD IN WYOMING

(MINE REPORT)

By RICHARD H. MOTE

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SUMMARY

Of the gold, silver, copper, and lead mines in Wyoming only one—the Midas mine, Atlantic City district, Fremont County—produced in 1944. The ore output was 6 short tons, containing 20 fine ounces of gold and 3 fine ounces of silver, and was shipped to a smelter at Garfield, Utah.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1940-44

Year	Gold ¹	Silver ²	Copper ³	Lead ⁴	Zinc ⁵
	Per fine ounce	Per fine ounce	Per pound	Per pound	Per pound
1940	\$35.00	\$40.711+	\$0.113	\$0.050	\$0.063
1941	35.00	40.711+	.118	.057	.075
1942	35.00	40.711+	.121	.067	.093
1943	35.00	40.711+	.130	.075	.108
1944	35.00	40.711+	.135	.080	.114

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.

² Treasury buying price for newly mined silver.

³ 1940-41: Yearly average weighted price of all grades of primary metal sold by producers; 1942-44: Price includes bonus payments by Metals Reserve Co. for overquota production.

⁴ \$0.7111111.

The following table shows the annual output of ore from lode mines producing gold, silver, copper, and lead and the quantity and value of the metals recovered from both lode and placer mines in Wyoming from 1940 to 1944; it also gives the total production of metals from 1867 to 1944. About three-fourths of the total recorded value of the four metals is in copper, most of which was mined before 1924 in the Encampment district, in Carbon County, and the Hartville district, originally in Laramie County, now in Platte County.

Mine production of gold, silver, copper, and lead in Wyoming, 1940-44, and total, 1867-1944, in terms of recovered metals

Year	Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)		Copper		Lead		Total value
		Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	
1940	813	740	\$25,900	114	\$81	4,000	\$452			\$26,433
1941	159	478	16,730	94	67	8,000	944			17,741
1942	84	23	805	52	37			6,000	\$402	1,244
1943										
1944	6	20	700	3	2					702
1867-1944	(1)	77,934	1,836,018	74,635	51,754	16,325	5,684,048	11	970	7,572,790

¹ Figures not available.

² Short tons.

SECONDARY METALS—NONFERROUS

By HERBERT L. CULLEN ¹

SUMMARY OUTLINE

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GENERAL SUMMARY

Final figures on the recovery of nonferrous secondary metals from purchased scrap in 1944 reveal continuation of the high rate of production of material from secondary sources, with only slight declines in the recovery of some of the metals surveyed, and significant gains in the tonnages of the light metals aluminum and magnesium reclaimed from scrap. The fabrication of metal parts for war production resulted in the continued flow of most types of new scrap to wrought-alloy producers, ingot makers, and foundries, although a substantial decline was registered in recovery of both copper and zinc from new scrap, due to cut-backs effected in the ammunition program. However, the losses in recovery of copper and zinc from new scrap were almost balanced by gains in recovery from old scrap, mainly because of the return of large quantities of fired cartridge cases to the industry for remelting. In general, the ratio of new scrap to old scrap used was nearer the prewar level than in 1943, when unprecedented production schedules upset the balance between the use of the two types to a marked degree by the generation of an unusual volume of new scrap.

Salient statistics of nonferrous secondary metals recovered in the United States, 1943-44

Metal	New scrap		Old scrap		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1943						
Aluminum.....	280,867	\$81,002,042	33,094	\$9,544,310	313,961	\$90,546,352
Antimony.....	62	19,741	15,421	4,910,046	15,483	4,929,787
Copper.....	658,526	155,412,136	427,521	100,894,956	1,086,047	256,307,092
Lead.....	31,391	4,018,048	310,703	39,769,984	342,094	43,788,032
Magnesium.....	11,254	4,735,683	150	63,120	11,404	4,798,803
Nickel.....	5,058	3,540,600	1,859	1,301,300	6,917	4,841,900
Tin.....	12,643	13,148,720	25,177	26,184,080	37,820	39,332,800
Zinc.....	284,263	48,893,236	84,225	14,486,700	368,488	63,379,936
		310,770,206		197,154,496		507,924,702
1944						
Aluminum.....	302,746	86,706,454	22,899	6,558,274	325,645	93,264,728
Antimony.....	328	103,910	15,558	4,928,775	15,886	5,032,685
Copper.....	494,232	116,638,752	456,710	107,783,560	950,942	224,422,312
Lead.....	41,483	5,309,824	289,933	37,111,424	331,416	42,421,248
Magnesium.....	14,081	5,773,210	104	42,640	14,185	5,815,850
Nickel.....	2,123	1,486,100	2,198	1,538,600	4,321	3,024,700
Tin.....	11,240	11,689,600	21,349	22,202,960	32,589	33,892,560
Zinc.....	232,308	39,956,976	113,161	19,463,692	345,469	59,420,668
		267,664,826		199,629,925		467,294,751

¹ Revised figures.

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

The value of metals recovered in 1944 from both new and old scrap was \$467,294,751, compared with \$507,924,702 in 1943. This decline was due to the drop in value of metals recovered from new scrap—from \$310,770,206 in 1943 to \$267,664,826 in 1944; in contrast, the value of metals reclaimed from old scrap rose from \$197,154,496 in 1943 to \$199,629,925 in 1944.

Secondary metals recovered as unalloyed metal, in alloys, and in chemical compounds in the United States, 1940-44, in short tons

Metal	1940	1941	1942	1943	1944
Aluminum.....	80,362	106,857	196,464	313,961	325,645
Antimony.....	11,421	21,629	18,200	15,483	15,886
Copper.....	532,046	726,396	927,755	1,036,047	950,942
Lead.....	260,346	397,416	323,001	342,094	331,416
Magnesium.....	(¹)	1,752	6,238	11,404	14,185
Nickel.....	4,152	5,315	4,142	6,917	4,321
Zinc.....	33,222	42,033	37,918	37,820	32,589
Total.....	222,013	283,967	330,526	368,488	345,469

¹ Revised figure.

² Data not available.

The importance of secondary metals in the mineral economy of the Nation has been demonstrated during the war years by the prominent position these metals have occupied in the war production program. Certainly, the role of secondary metals in the coming peacetime economy merits a constructive program of scrap salvage and consumption, in order that our mineral resources, both above ground and underground, may be utilized in the most efficient manner. This was forcefully brought out in a recent paper by Pehrson,² who reviewed the findings of a joint committee of geologists and mining engineers from the Geological Survey and the Bureau of Mines, that recently surveyed the mineral resources of our country.

The gist of the discussion regarding the eight nonferrous metals on which canvasses concerning secondary metal recovery are conducted was that for only one, magnesium, does the United States occupy a comfortable reserve position. Our reserve position in the other metals discussed in this chapter—aluminum, copper, lead, tin, zinc, nickel, and antimony—is not so fortunate. Commercial reserves, expressed in years' supply remaining in 1944 at the prewar rate of use, are as follows: Copper, 34 years; zinc, 19 years; lead, 12 years; aluminum (bauxite), 9 years; antimony, 4 years; nickel and tin, less than 1 year. Our known deposits of the last two elements have always been negligible, and war-induced explorations have not disclosed appreciable new commercial reserves. It may be readily seen that the enormous consumption of materials since 1900 has seriously depleted reserves of minerals on which a great part of the industrial structure of the Nation has been built.

Some waste of resources still occurs through the use of inadequate techniques, but industry is to be commended for technologic improvements in the past few years leading to the increased recovery of secondary metals. Research and engineering and the scrap-metal industry should be recognized as the greatest conservational forces working today toward the preservation of our mineral economy.

² Pehrson, E. W., *The Mineral Position of the United States and the Outlook for the Future*: Min. and Met., vol. 26, No. 460, April 1945, pp. 204-214.

Many of the improvements in metal technology during the war years have been the direct result of orders issued by the War Production Board in effecting transition of the metal industries to a war basis. The most far-reaching effects were produced by the various orders that made mandatory the segregation of specified types of nonferrous scrap. The orders limiting the use of certain metals caused many companies to branch out into new manufacturing fields, with the salutary result that they had to install the most modern methods to utilize their plants in the war program. In addition, the reporting requirements set by the War Production Board and the Office of Price Administration, which were instituted by those agencies for the purpose of obtaining working information, proved to be the means of bringing to the attention of many operators of smaller metal-working establishments the value of keeping adequate records on consumption and production of materials, which would make more feasible the preparation of operating-cost data.

POSTWAR OUTLOOK

Owing to the enormous need for both capital and consumer goods that has accumulated during the war years, the demand for most types of nonferrous metal scrap should continue near the wartime level. Moreover, the anticipated decline in primary metal production when premium payments are discontinued should place a larger proportion of the supply burden on secondary sources. This is certainly true of the metals (copper, zinc, lead, and antimony) with long-established fields of use because manufacturers will demand them to recapture civilian markets lost during utilization of their plants in war production. The demand for the light metals aluminum and magnesium in the immediate postwar period depends largely upon the extent to which they replace other materials in manufacture and construction; consequently, future demand for aluminum and magnesium scrap remains obscure.

The prospect for a balance of supply of scrap materials against demand appeared to be good. Earlier fears that enormous quantities of industrial scrap would be turned into the market upon the termination of war contracts were allayed somewhat as military and naval authorities collaborated with the War Production Board in outlining a more gradual conversion to civilian production. There was no evidence by the end of the year, or even after the end of the war in Europe, that any disturbing amount of nonferrous scrap would be forthcoming from manufacturing plants being forced to reconvert; instead, as metal stock and semifinished material were shown to be surplus, they were allocated quickly to other consumers, and clean-up scrap found a ready market.

During 1944 and the early part of 1945 it was the general practice of both the Army and the Navy to make a special effort to return only fired cartridge cases to this country from overseas. Other types of battlefield scrap were considered too difficult to segregate and prepare and too bulky to permit economical reshipment and were returned only when readily available at the ports. In addition, it was believed that foreign markets could more readily absorb the material; just before the end of the war in Europe a substantial tonnage of cartridge cases was allotted to France in lieu of virgin copper.

Stocks of wrecked aircraft scrap steadily increased in dealers' yards and Metals Reserve Company stock piles throughout 1944, and

the effective utilization of this material, with the potential supply of such magnitude, threatened to become the biggest single problem of the secondary metal industries. However, a new method of using such scrap was being developed early in 1945 that offered some prospect of solving this problem. This, process, developed by the Aluminum Ore Co., employs some of the solution used in the Bayer process for bauxite to dissolve the aluminum from wrecked and war-weary aircraft scrap in huge tanks built especially for the purpose. The aluminum emerges as alumina for further treatment in primary reduction plants; and the other elements in the scrap—such as magnesium, copper wire, and steel rivets—are raked from the tank periodically for sorting and possible resale. The process is still in the experimental stage, and costs for commercial application have not been determined.

In setting up the Surplus War Property Administration it was decided that, in the case of scrap, the owning agency should handle its disposal. The salvage agencies of both the War and Navy Departments have been active in channeling all types of scrap back to consumers to facilitate production, thereby reducing the amount of material remaining to be sold by these departments after the war.

SCOPE OF REPORT

Statistics on scrap and secondary metal for 1944 were accumulated from a number of canvasses covering all known consumers of purchased nonferrous scrap metals and a representative group of dealers. Reports were received monthly or annually from 368 plants classed as remelters, smelters, or refiners; from 1,077 plants classed as rolling mills, foundries, chemicals works, or other manufacturers; and from a representative group (approximately 2,100) of the 4,500 dealers in nonferrous scrap metal. The larger consumers of scrap in the secondary lead and zinc industries, as well as the selected group of 2,100 dealers, were canvassed monthly by the Bureau of Mines, but figures for consumption of aluminum scrap and ingot production by makers of aluminum ingot and the detailed break-down of copper alloys produced by brass ingot makers, were taken from monthly surveys conducted by the War Production Board. All other figures in this report were derived from annual canvasses conducted by the Bureau of Mines.

"Secondary metals" are metals or alloys recovered from scrap and residues. The term "secondary" applies only to the source of metal and has no relation to the type of product recovered, either as to degree of purity or impurity or physical characteristics.

"Purchased scrap" means all scrap that entered any plant in scrap form and includes scrap treated for customers upon a toll basis or conversion agreement and interplant transfers of scrap. Scrap salvaged by railroads from line operations and melted in their own foundries and that melted by Navy Yard foundries which originated in salvage operations are included in this category, as a definite recovery of secondary metal can be counted from the melting of such scrap.

"Interplant transfers" are those made between separate plants owned or operated by the same parent company but not located on the same ground. A transfer of scrap from a machine shop to a

foundry at the same plant location is not an interplant transfer, and such "home scrap" is not included in this report.

"New scrap" is defined as the refuse produced during the manufacture of articles for ultimate consumption, including all defective finished or semifinished articles that must be reworked. Typical examples of new scrap are defective castings, clippings, punchings, turnings, borings, skimmings, drosses, and slag.

"Old Scrap" is defined as scrap consisting of metal articles that have been discarded after serving a useful purpose. Typical examples of old scrap are discarded trolley wire, battery plates, railroad-car boxes, fired cartridge cases, automobile crankcases, used pipe, and lithographers' plates.

SECONDARY ALUMINUM¹

The year 1944 saw the recovery of aluminum from scrap rise to a new record, totaling 325,645 short tons valued at \$93,264,728 compared with 313,961 tons valued at \$90,546,352 in 1943. Values were calculated on the basis of the replacement value of primary aluminum at 14.32 cents a pound in 1944 and 14.42 cents in 1943. The quantity recovered has risen steadily each year since 1938, under the impetus of enormous supplies of new industrial scrap made available from war production activities.

Secondary aluminum¹ recovered in the United States, 1943-44, in short tons

Secondary aluminum recovered			Recoverable aluminum-alloy content of scrap		
Form of recovery	1943	1944	Kind of scrap processed	1943	1944
As metal.....	5,926	2,336	New scrap:		
Aluminum alloys.....	305,357	320,040	Aluminum-base ²	280,065	302,230
In brass and bronze.....	1,279	1,466	Copper-base.....	724	429
In zinc-base alloys.....	219	1,187	Zinc-base.....	78	87
In chemical compounds.....	1,180	1,616		280,867	302,746
	313,961	325,645	Old scrap:		
			Aluminum-base ²	32,414	22,359
			Copper-base.....	540	440
			Zinc-base.....	140	100
				33,094	22,899
				313,961	325,645

¹ In accordance with common usage, the term "aluminum" covers aluminum alloys, and the figures include all constituents of the alloys recovered from aluminum-base scrap.

² Recoverable aluminum content of new aluminum-base scrap was 261,282 tons in 1943 and 281,804 tons in 1944.

³ Recoverable aluminum content of old aluminum-base scrap was 29,714 tons in 1943 and 20,495 tons in 1944.

The production⁴ of realloyed (secondary) aluminum ingot continued its upward trend, totaling 214,879 short tons in 1944, compared with 196,373 tons in 1943 and 144,694 tons in 1942, and recovery of secondary aluminum in wrought products from purchased scrap at aluminum rolling mills increased from 53,080 tons in 1942 to 121,827 tons in 1943, then declined slightly to 116,582 tons in 1944. The continued use of large amounts of scrap in wrought-aluminum products

⁴ The term "secondary aluminum" is used broadly to cover aluminum and aluminum alloys, including the weight of alloy constituents, such as copper, silicon, magnesium, and others.

⁵ Figures for aluminum scrap consumed by smelters and aluminum ingot produced were derived from a survey conducted by the War Production Board.

was made possible by simple methods of marking sheet, tube, and shapes with the appropriate alloy number, so that the number would appear on almost every piece of industrial scrap of any size and greatly facilitate identification and segregation of alloy types.

Production of secondary aluminum and aluminum-alloy products in the United States, 1942-44, gross weight, in short tons

	1942	1943	1944
Secondary aluminum ingot: ¹			
Pure aluminum (98.5 percent)	2,924	715	1,151
Al-Si (silicon)	2,890	471	2,885
Other aluminum-silicon alloys	10,303	13,348	14,600
No. 12 aluminum	13,577	11,392	19,735
Other aluminum-copper alloys	24,135	25,160	9,772
Aluminum-copper-silicon alloys	21,480	24,861	20,744
Aluminum-copper- or aluminum-silicon-nickel alloys			11,864
Steel-mill ingot and shot	38,527	32,770	48,652
Die-casting alloys	7,928	8,300	22,631
Aluminum hardeners	2,731	6,267	5,961
Wrought alloys	18,874	45,063	21,651
"Primary grade" ingot ²		1,401	17,078
Ingot for chemicals, powder, etc.		14,536	5,638
Piston alloys	120	10,205	11,815
Miscellaneous	1,109	1,794	702
Aluminum in wrought products ⁴	144,694	196,373	214,879
Aluminum powder	53,040	121,827	116,582
Aluminum alloy castings	848	961	4,346
Aluminum in chemicals	480	448	8,660
	1,668	1,180	1,616

¹Gross weight of alloys, including copper, silicon, and other added elements; total secondary ingot consumed 565 tons of primary aluminum in 1942, 8,471 tons in 1943, and 8,792 tons in 1944.

²"Primary grade" ingot is a new classification of ingot made from scrap with primary aluminum added to bring specifications of the alloys equal to those made entirely from primary metal.

³Includes 18,552 tons produced on toll in 1943 and 9,089 tons in 1944.

⁴Combined with primary aluminum in the products of aluminum rolling mills.

⁵Does not include production measured as ingot for graining, powder, atomizing, or chemical purposes.

The acceptance of secondary aluminum in fields formerly supplied by primary aluminum increased in 1944, as it was demonstrated that aluminum alloy ingot meeting the most rigid specifications could be supplied from remelt materials. This was due in part to general improvement in smelting methods but was more directly the result of extreme care in the handling of scrap, as fabricating plants, dealers, and smelters all bent their efforts toward solving the problems of segregation of alloy types and the holding of impurities such as iron to a minimum.

In spite of these technologic advances, the tonnage of wrought-aluminum alloys made by secondary smelters declined from 45,063 tons in 1943 to 21,651 tons in 1944 because most of the segregated wrought scrap was being channeled back to primary plants. The secondary smelters consumed greater amounts of casting-alloy scrap and turnings and borings, and their production of ingot was heavier in such groups as the casting and piston alloys, and ingot for deoxidation. As some of the restrictions on the melting of aluminum, which had been in force since January 1942, were lifted in September of 1944, larger amounts of scrap were consumed in such products as castings, aluminum chemicals, and powder in the latter part of the year.

Makers of secondary aluminum ingot used 8,792 tons of primary aluminum and 6,822 tons of alloying ingredients, such as copper and silicon, in addition to aluminum scrap. Only a slight increase was made in the quantity of aluminum scrap consumed, from 352,124 tons in 1943 to 354,182 tons in 1944. Of the 1944 total, 220,553 tons or 62 percent, was used by ingot makers at 55 plants. As the restrictions of

War Production Board Order M-1-d regarding the melting of aluminum were relaxed on September 22, smelters were no longer designated as "limited" or "approved." Primary producers used 121,290 tons at 22 aluminum rolling mills, extrusion plants, and smelters; the remaining 12,339 tons were used by foundries, chemical works, and miscellaneous manufacturers. The downward trend in the use of old scrap, such as obsolete castings and old sheet and utensil, was continued through 1944, with only 25,223 tons of old scrap used compared with 34,266 tons in 1943 and 43,248 tons in 1942. The supply of new scrap, however, was plentiful, and 328,959 tons were used in 1944—an increase of 3 percent over the 317,858 tons consumed in 1943.

Consumption of purchased aluminum scrap in the United States in 1944, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries				Total scrap used
			Aluminum rolling mills		Foundries and other manufacturers		
	New scrap	Old scrap	New scrap	Old scrap	New scrap	Old scrap	
Pure clippings, wire, and foil.....	7, 329	-----	1, 765	-----	472	13	9, 579
Castings and forgings.....	10, 266	12, 208	55	2	8, 295	569	31, 395
Alloy sheet.....	25, 504	1, 196	112, 163	1, 301	7	34	140, 205
Scrap sheet and sheet utensil.....	6, 281	1, 893	1, 542	-----	32	7	9, 755
Borings and turnings.....	127, 812	-----	4, 461	-----	2, 015	-----	134, 288
Die castings.....	677	-----	1	-----	1	47	726
Wrecked aircraft.....	-----	7, 754	-----	-----	-----	1	7, 755
Miscellaneous aluminum and dross.....	19, 435	198	-----	-----	846	-----	20, 479
	197, 304	23, 249	119, 987	1, 303	11, 668	671	354, 182

¹ Includes 10,123 tons treated on toll.

Scrap-metal dealers increased their purchases of aluminum scrap again in 1944, with receipts of all types in their yards rising to 186,171 tons compared with 145,975 tons in 1943, a gain of 28 percent. Shipments by dealers to consumers totaled 156,804 tons during the year, a substantial increase over the 1943 figure of 130,295 tons, and more than 55 percent greater than the 100,796 tons shipped during 1942. Stocks in dealers' yards rose steadily from 25,072 tons on January 1 to 55,812 tons at the end of the year. A comparison of these figures with the 8,720 tons in dealers' hands at the end of 1942 shows the rate at which stocks of this scrap have accumulated. Dealers' prewar stocks of aluminum scrap averaged approximately 4,000 tons.

During the first 9 months of 1944, dealers bought great quantities of wrecked aircraft scrap. A special survey by the Bureau of Mines of a large number of dealer purchases showed that the average price paid for it was about \$12.50 a ton. However, purchases of this material slackened considerably after October 2, 1944, when the Surplus War Property Administration ruled that bids below \$25 a ton would be rejected and the scrap stock-piled by Metals Reserve Company. Wrecked aircraft scrap purchased by dealers at such low prices was one of the contributing factors in the rise in aluminum scrap inventories, since there was a limited smelter demand for this type of material. As it presented a preparation problem of some magnitude, the indications were that the dealers planned to hold it until the manpower

situation was easier, or until new technologic developments enhanced its future value.

In an effort to solve a storage problem, the Navy Department built melting furnaces at six naval air stations for melting wrecked aircraft scrap into low-grade ingot. Approximately 1,600 tons of this ingot were sold by the Naval Material Redistribution and Disposal Authority during the latter part of the year.

It appeared that wrecked aircraft scrap would not be returned to the United States from world-wide battle areas in large quantities, owing to the lack of transportation and manpower, the expense, and the inaccessibility of crashed or damaged planes. However, considerable tonnages of aircraft scrap promised to accumulate from operations in and near this country, as was demonstrated by steadily rising inventories of this material in dealers' yards and Metals Reserve Company stock piles. There also remained the uncertain quantity evolved by the removal from service of thousands of planes after the war. In view of this outlook of certain oversupply, research was under way at the end of the year to work out a satisfactory method of utilizing such scrap, promising results being obtained shortly afterward.

Consumers' stocks of purchased aluminum-based scrap in the United States at end of year, 1943-44, gross weight, in short tons

Scrap Item	On hand—	
	Dec. 31, 1943	Dec. 31, 1944
Castings and forgings.....	785	1,689
Sheet, turnings, clippings, etc.....	7,843	12,367
Miscellaneous aluminum and dross.....	3,109	1,611
	11,737	15,667

As the supply of aluminum became more plentiful during 1944, the War Production Board issued a number of amendments to, and revocations of, the various restrictive orders, each designed to permit the wider use of aluminum, specifically lifting the burden of restrictions from aluminum foundries. C. M. P. Regulation 5, Direction 1, as amended April 26, stated that any foundry may melt aluminum scrap in the form of obsolete or defective patterns furnished by the prospective purchaser of the new pattern without prior authorization. Shortly after, on May 3, the War Production Board rescinded an order issued on February 19, 1942, which had instructed foundries to procure all their requirements of aluminum alloys from secondary smelters. Finally, on September 22, Order M-1-d was amended, so that nearly all restrictions on the receipt and use of aluminum scrap were lifted, and mandatory segregation of aluminum scrap was no longer required. This last amendment brought about a large and immediate increase in purchases of scrap by foundries.

The ceiling price for secondary aluminum ingot, high-grade, which had dropped to 12.5 cents on December 18, 1943, remained at that price throughout 1944, although smelters were permitted to charge 15 cents for the primary-grade ingots, containing 30 percent to 50 percent primary aluminum. During most of the year the actual selling prices were less than ceiling, indicating that production was

pace demand under the Controlled Materials Plan. As the supply of aluminum scrap of all types except the purer grades was more than adequate during the year, the maximum price declined to 10 cents a pound in December, although most sales were consummated at prices below ceiling. However, premium prices were allowed for segregated scrap that had been bundled or briquetted and for foil suitable for use in paints and chemicals.

Dealers' buying prices for cast-aluminum scrap in New York averaged 4.04 cents per pound in 1944, the lowest yearly average since 1932 and 2.95 cents per pound below the 1943 average of 6.99 cents. The yearly average price for this scrap has decreased steadily since 1941. Monthly average quotations opened at 5.03 cents in January and were down to 4.25 cents by April. This price was maintained until August, after which the monthly average dropped gradually to the year's low point of 3.12 cents in December. The yearly average price for new aluminum clippings was 5.12 cents per pound compared with 7.72 cents in 1943. The yearly average for this scrap also has dropped steadily since 1941. The monthly average gradually decreased from 5.75 cents in January to 4.87 cents in September and remained at the latter figure through December.

SECONDARY MAGNESIUM

During 1944, 14,185 short tons of secondary magnesium (including alloying ingredients) were recovered from scrap, representing an increase of 24 percent over the 11,404 tons reclaimed in 1943. The value of this secondary magnesium was \$5,815,850 computed at 20.50 cents a pound in 1944, compared with \$4,798,803 computed at 21.04 cents a pound in 1943.

Capital and consumer goods and war matériel made of magnesium still had not begun returning to foundries and secondary smelters in any quantity, and recovery of magnesium from old scrap amounted to less than 2 percent of the total. Owing to the machinability of magnesium alloys and to the fact that many plants were just learning to produce articles from them, the generation of borings, turnings, and savings was out of proportion to normal practice, and the tonnage of this type of scrap used constituted 89 percent of the total.

A total of 14,419 tons of secondary magnesium alloy ingot was produced by secondary smelters during 1944. This ingot required the blending of 3,202 tons of primary magnesium and minor tonnages of other alloying constituents, in addition to the purchased scrap consumed.

Secondary magnesium recovered in the United States, 1943-44, in short tons

Type of product or use	1943	1944
Magnesium-alloy ingot ¹ (gross weight).....	11,009	13,379
Magnesium-alloy castings (gross weight).....	327	235
In aluminum alloys.....	34	23
In lead alloys.....		2
In zinc alloys.....	1	5
Consumed in chemical and incendiary uses.....	33	541
From new scrap.....	11,404	14,185
From old scrap.....	11,254	13,976
	150	209

¹ Figures include secondary magnesium incorporated in primary magnesium ingot.

Because of trouble in certain foundries with contamination of foundry sand by tiny particles of magnesium oxide and the resulting surface defects on castings, there was a general reaction against the use of home scrap, such as runners, gates, and risers in foundry melts, and this material was shipped to smelters in some instances, its use by these consumers depending upon its physical condition. However, foundry operators reported the recovery of 235 tons of secondary magnesium from purchased scrap in magnesium-alloy castings in 1944. This represented a decline of 28 percent from the 327 tons recovered in castings in 1943, indicating a general improvement in technique, since the greater part of the casting scrap used in the 2 years was new scrap, such as rejected castings.

The consumption of magnesium scrap in chemical and incendiary uses showed an astonishing gain in 1944, the recovery of magnesium in such applications increasing from 33 tons in 1943 to 541 tons in 1944. Chemical applications included the use of magnesium scrap in fluxing compounds, in the Grignard reaction, and in the production of magnesium nitrate and chloride, the incendiary uses being in the production of war material such as flares and incendiary bombs. In spite of the employment of magnesium scrap for such a wide variety of purposes, the fire hazard presented by its storage, especially in the finely divided state, prevented full utilization of this material, because large quantities were disposed of by burning to avoid the risk incident to storage.

Stocks and consumption of magnesium scrap in the United States in 1944, gross weight, in short tons

Kind of scrap	On hand—		Consumption during 1944
	Dec. 31, 1943	Dec. 31, 1944	
Cast scrap.....	32	31	1,706
Solid wrought scrap.....	14	3	129
Borings, grindings, drosses, etc.....	279	60	15,179
	325	94	17,014

Owing to the difficulties experienced by the War Production Board in obtaining full production of magnesium materials, because of the general reluctance of industry to use this relatively new member of the commercial metal family, action was taken during October 1944 to ease the Government restrictive controls over the metal, including scrap and secondary magnesium, by the issuance of Supplementary Limitation Order L-2-C. Although the reporting requirements were retained regarding use and production of material for purposes of information, the new order had the effect of assuring manufacturers that magnesium could be obtained without the involved procedures necessary in obtaining most other metals. The order stated that "persons wishing to acquire magnesium or magnesium products may place purchase orders on their supplier, without securing approval * * *."

Maximum prices on magnesium scrap and remelt ingot were continued through 1944 without change, having been established under Maximum Price Regulation 302 on January 20, 1943. New segregated solids were exempt from price ceilings, but segregated

borings had a maximum price of 9 cents a pound, with mixed borings at 8 cents and mixed solids at 12 cents. The ceiling on class A remelt ingot was set at 21.5 cents a pound.

SECONDARY COPPER AND BRASS

The recovery of secondary copper in 1944 totaled 950,942 short tons valued at \$224,422,312, a decline of 12 percent from the 1,086,047 tons valued at \$256,307,092 recovered in 1943. The value of copper has remained at 11.8 cents a pound, exclusive of Metals Reserve Company bonus payments, for the past 4 years.

Recovery of copper from old scrap, instead of decreasing as was expected, climbed to 456,710 tons, or 7 percent more than the 427,521 tons recovered in 1943. The principal cause of this increase was the expeditious handling of fired cartridge cases, of which 136,448 short tons were used during the year. Salvage agencies of the War and Navy Departments bent every effort to return cartridge cases to the industry, in order that the ammunition program might not suffer from a shortage of materials, and Army sources alone reported the sale of over 100,000 tons, more than half of which came from overseas. In addition, nonferrous scrap dealers were instrumental in collecting a large amount of old scrap, handicapped as they were by shortages of manpower, gasoline, and tires.

Secondary copper recovered in the United States, 1943-44, in short tons

Secondary copper recovered			Recoverable copper content of scrap		
Form of recovery	1943	1944	Kind of scrap processed	1943	1944
As unalloyed copper:			New scrap:		
At primary plants.....	122,464	86,398	Copper-base.....	643,623	479,244
At other plants.....	15,419	15,737	Aluminum-base.....	13,348	14,586
	137,883	102,135	Nickel-base.....	1,555	401
			Tin-base.....		1
In brass and bronze.....	912,782	814,898		658,526	494,232
In alloy iron and steel.....	1,021	2,454			
In aluminum alloys.....	19,396	17,054	Old scrap:		
In other alloys.....	1,946	1,044	Copper-base.....	425,264	454,938
In chemical compounds.....	13,019	13,357	Aluminum-base.....	1,064	949
	948,164	848,807	Nickel-base.....	469	648
			Tin-base.....	184	175
	1,086,047	950,942		427,521	456,710
				1,086,047	950,942

Cut-backs in the manufacture of munitions in the late summer and fall months caused a 25-percent drop in the recovery of copper from new scrap—from 658,526 tons in 1943 to 494,232 tons in 1944. Although the use of new scrap in 1944 declined from that in the previous year, it still was much higher than in a normal prewar year, indicating that the ratio of old copper scrap to new scrap used would be even higher after the return of the Nation to a peacetime economy. Certainly, large quantities of consumer goods, which had outlived their normal span of life during the war years, were to be scrapped as soon as new products appeared on the civilian market.

The production of refined copper (electrolytic grade) from scrap fell to 93,046 tons in 1944, a loss of 28 percent from the 128,836 tons produced in 1943. This decrease was attributed to the lower quantity

of purchased low-grade residues and refinery brass available for treatment, because brass ingot makers processed their own residues and skimmings in cupolas to produce a form of black copper suitable for stock alloying. Of the 12 refineries that reported the use of scrap, 9 were producers of primary copper. The total recovery of unalloyed copper from scrap declined from 137,883 tons in 1943 to 102,135 in 1944.

Analysis and production of secondary copper and copper-alloy products in the United States, 1943-44

Item produced from scrap ¹	Approximate analysis (percent)						Gross weight produced (short tons)	
	Cu	Sn	Pb	Zn	Ni	Al	1943	1944
Refined copper (electrolytic grade).....	100	---	---	---	---	---	128,836	93,046
Casting copper.....	99	---	---	---	---	---	2,938	2,933
Copper sheet, rod, tubing, etc.....	99	---	---	---	---	---	1,586	1,540
Copper powder.....	98	---	---	---	---	---	1,523	2,897
Copper castings.....	98	---	---	---	---	---	3,000	2,759
Total unalloyed copper products.....							137,883	102,135
Brass and bronze ingots:								
Tin bronze.....	88	10	---	2	---	---	71,145	53,552
Lead-tin bronze.....	88	6	1.5	4.5	---	---	66,822	108,336
Leaded red brass.....	85	5	5	5	---	---	134,241	123,686
Leaded semired brass.....	81	3	7	9	---	---	31,753	48,316
High-leaded-tin bronze.....	80	10	10	---	---	---	25,701	29,918
Do.....	84	6	8	2	---	---	16,877	24,473
Do.....	75	5	20	---	---	---	5,631	(²)
Leaded yellow brass.....	66	1	3	30	---	---	18,958	25,843
Manganese bronze.....	62	---	---	27	---	5	74,053	72,677
Aluminum bronze.....	89	---	---	---	---	10	9,836	5,517
Nickel silver.....	58	2	7	18	14	---	982	3,394
Do.....	65	4	3	5	22	---	1,856	
Low brass.....	80	---	---	20	---	---	1,891	(²)
Silicon bronze.....	92	---	---	4	---	---	5,278	5,096
Conductor bronze.....	94	2	2	2	---	---	1,682	(²)
Hardeners and special alloys.....	81	---	---	---	---	---	21,477	17,453
Total copper-alloy ingots.....							488,185	518,261
Brass mill billets made by ingot makers.....							33,449	33,180
Brass and bronze sheet, rod, tubing, etc.....							605,009	609,153
Brass and bronze castings.....							109,472	143,665
Brass powder.....							---	883
Copper in chemical products (content).....							13,019	13,357

¹ Production of this item combined with 80-10-10 group in 1944.

² Production of this item combined with leaded yellow brass in 1944.

³ Production of this item combined with 85-5-5-5 group in 1944.

⁴ Gross weight of secondary brass and bronze in commercial shapes. Includes 422,818 tons of copper, 246 tons of nickel, 4,390 tons of lead, 282 tons of tin, 177,255 tons of zinc, and 18 tons of aluminum in 1943; and 367,425 tons of copper, 275 tons of nickel, 4,210 tons of lead, 330 tons of tin, 156,830 tons of zinc, and 79 tons of aluminum in 1944.

⁵ Gross weight of secondary brass and bronze castings. Includes 91,548 tons of copper, 18 tons of nickel, 7,540 tons of lead, 5,838 tons of tin, and 4,228 tons of zinc in 1943; and 118,391 tons of copper, 29 tons of nickel, 6,887 tons of lead, 7,493 tons of tin, and 7,765 tons of zinc in 1944.

The commercial production of brass and bronze ingot climbed to a new record of 518,261 short tons (gross weight) in 1944, an increase of 6 percent over the 488,185 tons produced in 1943. The 518,261 tons of ingot contained 423,027 tons of copper, of which 46,533 tons came from primary refined copper and the rest from scrap. Total shipments of ingot during the year were 511,465 tons, so that stocks at producers' plants increased from 8,777 tons (revised) at the start of the year to 15,573 tons on December 31. Seventy-five plants produced brass and bronze ingot for sale in 1944, and two foundries made ingot for their own use. Copper shot and anodes and copper-nickel alloys were made at two additional plants that did not produce brass ingot.

The arrangement that had been made in 1943 to have brass ingot makers pour brass-mill billets and cakes from their scrap melts was continued in 1944 in four plants. These smelters produced 19,558 short tons of yellow rod brass, 9,056 tons of yellow brass, 2,417 tons of Muntz metal, 660 tons of commercial bronze, 647 tons of manganese bronze, 231 tons of tin bronze, 112 tons of red brass, and 66 tons of aluminum bronze. One of the plants had set its own brass mill in operation early in the year, so not all of the material listed was shipped to other plants for rolling and fabricating.

The operations of brass mills declined considerably from the 1943 level. A total of 540 tons of unalloyed copper products and 509,153 tons of brass and bronze sheet, rod, and tubing was recovered from scrap at 44 plants during 1944. As brass mills worked under a blanket scrap allocation from the War Production Board, they had little difficulty in obtaining all the scrap needed, working as they were on reduced production schedules. As a result, large tonnages of "brass-mill scrap" were used by ingot makers to help supply the augmented demand for their product.

Foundries produced 143,665 tons of brass and bronze castings from scrap during the year, an increase of 31 percent over the 109,472 tons made in 1943. By far the greatest part of this tonnage consisted of bronze railroad bearings remelted in railroad foundries and in plants of bearing companies on a toll basis.

Consumption of purchased copper scrap in the United States in 1944, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries				Total scrap used
			Brass mills		Foundries and other manufacturers		
	New scrap	Old scrap	New scrap	Old scrap	New scrap	Old scrap	
No. 1 wire and heavy	13, 379	63, 409	6, 111	2, 217	2, 839	16, 208	104, 163
No. 2 wire, mixed heavy, and light.....	18, 966	55, 087	10, 423	1, 583	3, 359	6, 586	96, 004
Composition or red brass	66, 254	69, 197	.....	.....	25, 999	37, 550	199, 000
Railroad-car boxes	17	300	.....	.....	.....	44, 833	45, 130
Yellow brass	57, 936	105, 384	318, 620	61, 516	3, 135	7, 410	554, 031
Cartridge cases	4, 585	40, 970	.....	86, 920	.....	3, 973	136, 448
Auto radiators (unsweated) .....	.....	16, 353	.....	.....	.....	136	16, 489
Electrotype shells .....	.....	2, 503	.....	.....	.....	40	2, 543
Bronze	10, 441	17, 419	3, 859	3	234	2, 596	34, 552
Nickel silver	817	1, 838	590	90	4	103	3, 442
Low brass	20, 671	435	18, 287	1, 437	33	8, 240	49, 103
Aluminum bronze	190	125	.....	.....	2, 914	38	3, 267
High-lead brass .....	.....	.....	.....	.....	.....	306	306
Low-grade scrap and residues	112, 476	49, 121	5	.....	1, 760	.....	163, 362
	305, 732	422, 141	357, 895	153, 766	40, 277	128, 049	1, 407, 860

The total consumption of purchased copper and brass scrap in 1944 was 1,407,860 short tons, a substantial decline from the record quantity of 1,533,823 tons used in 1943. Brass ingot makers and refineries decreased their consumption 8 percent to 727,873 tons, and the use of scrap by brass mills declined 16 percent to 511,661 tons, owing to the reduction in the manufacture of munitions. However, the brass and bronze foundries and other manufacturers that used purchased copper-base scrap raised their consumption by 26 percent to 168,326 tons. The remelting of fired cartridge cases skyrocketed from approximately 8,000 short tons in 1942 to 46,872 tons in 1943, then to 136,448 tons in

44. Brass mills consumed more than half of the total used in 44, most of the remainder being used by brass ingot makers, although cartridge cases were used for a number of other purposes, even coinage of the 1-cent piece, by admixture with primary copper.

As the exigencies of maritime transportation demanded prompt turn of vessels dispatched to Western European ports and Pacific seas, little opportunity was afforded for the return of overseas battle scrap. Ships unloading near battle areas could not wait to take on scrap, even if they were collected and ready, and the Army had itself too busy furnishing supplies to the front to bother with collection. However, Army sources stated they had somehow managed the return of approximately 55,000 short tons of fired cartridge cases, 764 tons of other copper and brass scrap, 2,249 tons of aluminum scrap, 1,150 tons of other nonferrous metal scrap, and 9,700 tons of iron and steel scrap during the year.

War Production Board authorities stated that the supply and consumption of copper-base scrap were in balance during all of 1944. According to the monthly surveys conducted by the Bureau of Mines, dealers' inventories showed remarkably little variation, and the supply was just tight enough to maintain prices at ceiling (with some slight exceptions) without causing any inconvenience, since it was augmented efficiently by bonus-induced primary copper production to balance the raw material situation effectively. Brass-ingot makers, working against an unprecedented demand for ingot and denied the blanket scrap allocations granted to brass mills, used 46,533 tons of primary copper, 11,262 tons of pig tin, and proportionate quantities of other refined metals to fill material requirements.

Consumers' stocks of purchased copper-base scrap in the United States at end of year, 1943-44, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1943 ¹	Dec. 31, 1944
Copper.....	10,234	8,885
Copper-base alloy.....	56,974	47,880
Other scrap and residues.....	34,567	24,175
Total.....	101,775	80,940

¹Revised figures.

Consumers' inventories of copper and brass scrap dropped 20 percent from 101,775 tons (revised) at the beginning of the year to 80,940 tons on December 31, 1944.

Shipments of copper and brass scrap by dealers to consumers during the year reached 501,493 tons, a gain of less than 1 percent over 496,943 tons shipped in 1943. A good percentage of the material collected by dealers was brass-mill scrap, although the normal route for this type of scrap, consisting of clips, punchings, and turnings, would be direct from the generators to the brass mills, since only the brass mills were normally allowed to melt it.

The ceiling prices on brass and bronze ingot were revised slightly on April 1, 1944. Upward revisions were made at that time in the prices of some types of ingot, including 85-5-5-5 at 13.00 cents a pound instead of 12.25 cents, and 80-10-10 at 15.75 cents instead of

14.25 cents; among the types whose price remained unchanged were yellow brass at 10.00 cents a pound and 88-10-2 at 16.50 cents.

Maximum prices for copper and brass scrap were revised on January 25, 1944, reducing the selling prices of five different grades of brass scrap on sales to copper refiners and ingot makers (these price changes were later revoked, on April 24th). At the same time, the Office of Price Administration announced specific maximum prices for two grades of scrap not previously priced, bringing to 48 the total number of scrap items covered by Maximum Price Regulation 20.

Ceiling prices for the basic copper-scrap items were unchanged, with No. 1 wire and heavy copper at 9.75 cents a pound, No. 2 wire and mixed heavy copper at 8.75 cents, and No. 1 composition at 9.00 cents a pound f. o. b. Scrap generated from the fabrication of brass stock produced by brass mills was officially designated as "brass-mill scrap" and maximum prices were first established on June 18, 1941. In 1944 the list contained 32 different classes, with a separate price within each class for clean heavy scrap, rod ends, and clean turnings. In general, brass-mill scrap could be sold only to dealers and brass mills, although allocations were made to other consumers during 1944.

The average dealers' buying price for No. 1 copper scrap at New York, which had held at 9.37 cents a pound throughout 1942 and 1943, continued until August 1944, when the market broke slightly because of optimism over the expected early termination of hostilities in Europe. The year's low point for this grade of scrap was reached in October at 9.13 cents, but the price rebounded to 9.37 cents by the end of the year, making the yearly average 9.34 cents. The price for No. 1 composition scrap during 1944, as in the previous year, was constant at 8.87 cents a pound.

Although the allocation of all copper and copper-base materials was continued through 1944, the scrap situation was improved to such an extent by the latter part of the year that complete allocation was unnecessary. Brass mills were granted blanket allocations for scrap, and other consumers who found themselves in need of a specific item or tonnage were quickly assisted by spot allocations. The rigid copper-conservation program was gradually relaxed, as far as use of copper materials was concerned, by the issuing of various amendments to existing conservation orders. However, complete relaxation of controls on copper was felt to be an impossibility until the end of the war, and the concessions made to civilian use provided for the release of only a minor tonnage of materials.

*Brass and copper scrap imported into and exported from the United States, 1943-44,
in short tons*

	1943	1944
Brass scrap imported.....	9,102	6,052
Scrap copper imported.....	3,002	1,055
Brass scrap exported.....	6	38
Scrap copper exported.....	(¹)	99

¹ Less than 1 ton

SECONDARY NICKEL

The total recoverable nickel content of nonferrous scrap used in 1944 was 4,321 short tons valued at \$3,024,700, a loss of 37 percent from the 6,917 tons valued at \$4,841,900 in 1943. As in the 3 previous years, the value was calculated at 35.0 cents a pound, the spot-delivery price of electrolytic nickel, including duty. This large decrease in recovery was due almost entirely to the operations of one company that consumed a great quantity of monel scrap gathered in a salvage campaign in 1943 but melted a relatively small tonnage of scrap in 1944.

Secondary nickel (nonferrous) recovered in the United States, 1943-44, in short tons

Secondary nickel recovered			Recoverable nickel content of scrap		
Form of recovery	1943	1944	Kind of scrap processed	1943	1944
Metal.....	796	392	New scrap:		
Nickel-base alloys.....	2,705	1,128	Nickel-base.....	4,385	1,693
Copper-base alloys.....	2,096	1,866	Copper-base.....	673	430
Cast iron and steel.....	522	525		5,058	2,123
Chemical compounds.....	798	410			
	6,917	4,321	Old scrap:		
			Nickel-base.....	1,215	1,522
			Copper-base.....	644	676
				1,859	2,198
				6,917	4,321

Includes only nonferrous nickel scrap added to cast iron and steel.

Recovery of nickel as metal declined from 796 tons in 1943 to 392 tons in 1944, and the production of secondary monel-metal pig, shot, and castings dropped from 3,336 tons in 1943 to only 1,100 tons in 1944. The production of copper-nickel pig and shot fell from 875 tons averaging 46 percent nickel in 1943 to 776 tons averaging 49 percent nickel in 1944. Consumption of all types of nickel scrap except pure nickel clippings declined from the previous year, the most important single factor in the loss being the drop in use of monel scrap, from 5,680 tons in 1943 to 2,997 tons in 1944. Consumers' stocks of nickel scrap increased from 1,509 short tons on December 31, 1943, to 2,045 tons on December 31, 1944, and stocks of nickel scrap in dealers' yards climbed from 811 tons to 1,994 tons in the same period.

Consumption of purchased nickel scrap in the United States in 1944, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Pure nickel.....	523	61	118	165	867
Monel metal.....	893	1,424	252	428	2,997
Nickel silver.....	308	1,438	4	103	1,853
Miscellaneous nickel alloys.....	2				2
Nickel residues.....	256	74	20		350
	1,982	2,997	394	696	6,069

This rise in dealers' and consumers' inventories, coupled with the decreased consumption of nickel scrap, graphically illustrates the

effect of the restrictive orders of the War Production Board regarding the use of nickel, even though steps were taken to relax the restrictions to a certain extent during the year. Nickel anodes, nickel salts, and plating solutions in inventory, which had been frozen since January 20, 1942, were released February 19, 1944, with the issuance of a Direction to Conservation Order M-6-b, delivery of such materials being restricted to persons who would use them in accordance with regulations. Another amendment to this order, issued on May 16, 1944, modified the rules governing the use of nickel solutions and nickel for necessary resistance materials. However, the order still stated that nickel may be freely used only in "implements of war," all ordinary domestic uses having been prohibited since April 1, 1942, and segregation of nickel scrap remained mandatory.

The maximum prices for nickel scrap remained unchanged throughout 1944, having been set at 26 cents a pound for pure nickel scrap and 20 cents a pound for new monel clippings on June 2, 1941. Dealers' buying prices for nickel clippings in New York were quoted at 20 cents a pound from the beginning of the year until August 30, when they dropped to 18.50 cents for the remainder of the year. Monel clips opened the year steadily at 16 cents and dropped to 14 cents on August 30 and then to 12.50 cents on October 5 for the remainder of the year. The average price of nickel clips was 19.50 cents and of monel clips 15 cents in 1944, compared with averages of 20.83 and 16 cents, respectively, in 1943.

There were no imports of nickel-bearing scrap reported in 1943 or 1944, but exports in 1944 amounted to 4,021 short tons, compared with 5,633 tons in 1943.

Consumers' stocks of purchased nonferrous nickel scrap¹ in the United States at end of year, 1943-44, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1943	Dec. 31, 1944
Unalloyed nickel.....	139	161
Nonferrous nickel alloys.....	1,108	1,339
Nickel residues.....	262	545
	1,509	2,145

¹ Includes nickel-silver scrap.

SECONDARY LEAD

Operations in the secondary lead industry remained at a high level during 1944, with 331,416 short tons of lead valued at \$42,421,248 recovered from scrap, compared with 342,094 tons (revised) valued at \$43,788,032 recovered in 1943. The decline was due entirely to the use of scrap items, such as battery-lead plates and drosses, which have a comparatively low lead content, as the total consumption of purchased scrap increased over the previous year. There were 61,700 tons of secondary soft lead produced compared with 58,591 tons in 1943, and the secondary lead content of antimonial lead also rose slightly, from 176,927 tons in 1943 to 180,818 tons in 1944. Secondary lead recovered in solder declined from 33,529 tons in 1943 to 22,245 tons in 1944, and the secondary lead content of type metals produced was 23,870 tons, showing little change from the 23,201 tons recovered in that product in 1943 and the comparable figure of 23,741 tons in 1942.

Examination of the figures reported reveals that, although the total recovery of lead from scrap declined in 1944, manufacturers of secondary lead products increased their tonnage of materials produced by adding larger percentages of primary metal than usual.

Secondary lead recovered in the United States, 1943-44, in short tons

Secondary lead recovered			Recoverable lead content of scrap		
Form of recovery	1943 ¹	1944	Kind of scrap processed	1943 ¹	1944
Total:			New scrap:		
At primary plants.....	1,863	11,368	Lead-base.....	22,361	33,127
At other plants.....	56,459	43,678	Copper-base.....	9,030	8,356
	58,322	55,046		31,391	41,483
Antimonial lead ²:	176,927	180,818	Old scrap:		
Other lead alloys.....	76,474	68,271	Battery-lead plates.....	152,649	164,106
Copper-base alloys.....	28,625	26,667	All other lead-base.....	141,560	113,145
Tin-base alloys.....	1,746	614	Copper-base.....	16,455	12,640
	283,772	276,370	Tin-base.....	39	42
	342,094	331,416		310,703	289,933
				342,094	331,416

¹ Revised figures.

² Includes 32,987 tons (revised figure) of lead recovered in antimonial lead from secondary sources at primary plants in 1943 and 34,475 tons in 1944.

Production of secondary lead, tin, and lead- and tin-alloy products in the United States in 1944, gross weight, in short tons

	Gross weight of product ¹	Secondary metal content			
		Lead	Tin	Antimony	Copper
Refined pig lead	38,696	38,696			
Remelt lead	22,669	16,015			
Lead foil	335	335			
	61,700	55,046			
Refined pig tin	4,000		4,000		
Remelt tin	466	7	222		
Tin foil	23		23		
	4,489	7	4,245		
Lead and tin alloys:					
Antimonial lead.....	222,378	180,818	266	10,894	
Common babbitt.....	25,099	14,756	1,179	1,563	22
Genuine babbitt.....	5,546	392	2,189	311	160
Other tin babbitts.....	636	215	259	38	8
Solder.....	46,204	22,245	4,892	207	3
Type metals.....	30,565	23,870	1,644	2,624	
Miscellaneous lead-tin alloys.....	5,805	1,963	74	248	
	336,233	244,259	10,503	15,885	202
Composition foil	5,576	5,437	138	1	
Tin content of chemical products	350		350		

¹ Difference between gross weight of product and secondary metal content represents added primary metals or impurity content.

Of the total secondary lead recovered, 310,420 short tons were reclaimed from lead- and tin-base scrap; the remaining 20,996 tons were lead contained in secondary brass and bronze and reclaimed by remelting copper-base scrap. An additional 5,671 tons of lead in lead-base scrap was added to brass and bronze, bringing the total recovery of secondary lead in these products to 26,667 tons.

Consumption of purchased lead scrap in the United States in 1944, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Soft lead.....		45,284	2,784	541	48,609
Hard lead.....		16,788		114	16,902
Cable lead.....		8,159	21	94	8,274
Battery-lead plates.....		246,255		3	246,258
Mixed common babbitt.....		16,313	13	2,228	18,554
Solder and tinny lead.....	304	12,072		56	12,432
Type metals.....		14,482		174	14,656
Dross and residues.....	48,414	15,150	12		63,576
	48,718	374,503	2,830	3,210	429,261

The gross weight of lead-base scrap consumed during 1944 amounted to 429,261 short tons, an increase of 2 percent over the 420,534 tons used in 1943. The use of battery-lead plates rose 17,193 tons, and that of drosses and residues 13,675 tons; but consumption of hard lead scrap dropped 3,995 tons, of cable lead scrap 9,380 tons, of solder scrap 5,257 tons, and of type metals 3,765 tons. The operations of remelters and smelters during the year were reflected in their use of lead-base scrap, which was steady in the first quarter, dipped sharply in April, then reached the year's low mark of 28,913 tons in June, after which it climbed to the peak in October, with 38,223 tons consumed.

Owing to the fact that the demand for lead constantly exceeded supply, Metals Reserve Company stock piles of the metal were gradually reduced until, at the end of 1944, their stock equaled approximately 1 month's supply. The consequent calls on the secondary lead industry to augment its production were met by smelters to the best of their ability; however, they were hampered by a shortage of labor for processing scrap, especially battery plates and drosses, and by unusually severe weather at the end of the year.

Percentage metals circulated in pig form among remelters and smelters during 1944 totaled 61,374 short tons, consisting of 36,951 tons of antimonial lead, 6,589 tons of soft lead, 6,322 tons of solder, 4,536 tons of type metal, 4,373 tons of lead-base bearing metal, 1,114 tons of tin babbitt, 905 tons of cable lead, 374 tons of silver-lead solder, 188 tons of remelt tin, 19 tons of pewter, and 3 tons of tin-bearing lead.

There was little change in inventories of lead scrap at consumers' plants, total stocks on December 31, 1944, being 71,598 short tons, compared with 71,500 at the end of the previous year. Because of continued demand, stocks of soft lead scrap remained at a very low point—probably a working minimum—being 2,457 tons at the end of the year or virtually the same as the 2,459 tons reported at the end of 1943. During the same period inventories of lead-base alloys declined 1,862 tons, but stocks of drosses and residues gained 1,962 tons. War Production Board authorities constantly campaigned for greater use of drosses and residues, in order to increase production of secondary lead, but manpower difficulties prevented smelters from fully utilizing their stocks of these materials.

Consumers' stocks of purchased lead-base scrap in the United States at end of year, 1943-44, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1943	Dec. 31, 1944
Refined lead.....	2,459	2,457
Lead-base alloy.....	37,647	35,785
Dross and residues.....	31,394	33,356
	71,500	71,598

Scrap-metal dealers' stocks of lead-base scrap, which declined from 35,810 short tons on December 31, 1943, to a low of 31,023 tons at the end of May, showed a fairly steady increase for the rest of the year, amounting to 38,906 tons on December 31, 1944, the highest point in 3 years. Shipments of lead scrap by dealers to consumers totaled 253,165 tons in 1944, compared with 279,580 tons in 1943. As the demand on dealers for lead scrap was constant, the movement of scrap through dealer channels was also steady, with peaks of activity in January and October.

There were no changes in the maximum prices for lead scrap during 1944. Prices had been set on January 15, 1942, and with the addition of new basing points to the schedule were continued throughout 1943 and 1944. With the ceiling on primary pig lead at New York fixed at 6.50 cents a pound, the comparable price for heavy lead scrap, according to the formula delineated in the schedule, was the base price of primary lead less 0.55 cent, or 5.95 cents a pound.

Dealers' buying prices for heavy lead scrap remained 5.37 cents a pound throughout 1943 and 1944, there being no change in the monthly average quotation since August 1942. Dealers' buying prices for battery-lead plates at New York averaged 2.885 cents a pound for the year, ranging from 2.875 cents at the beginning of the year to 3 cents during the summer, then to 2.75 cents in October. Battery-plate smelting charges, which determined the dealers' net selling price, were not usually quoted, toll agreements for smelting scrap being prohibited except on authorization by the Office of Price Administration.

Although both scrap and secondary lead were subject to allocation by the War Production Board, no interference with the free movement of these materials was necessary. As a matter of fact, the only lead allocated was that from Metals Reserve Company stock piles, the greater portion of which was imported. However, as the supply of lead gradually grew scarcer during 1944, it was found necessary to issue on December 26 a drastic amendment to General Preference Order M-38 which prohibited the manufacture of a few additional articles from lead and restricted the use of lead in a long list of other articles to 30 percent, during a calendar quarter, of the amount used in those articles during the first 6 months of 1944. The amendment also restricted inventories of lead in all forms to a 45-day supply. Dealers in lead and lead scrap and refiners of lead, however, were specifically exempted from this provision of the Order.

There were no exports of lead scrap from this country reported in either 1943 or 1944. Imports from other countries jumped from 496 short tons (lead content) to 3,313 tons (lead content) in 1944.

SECONDARY TIN

Secondary tin recovered from scrap in 1944 totaled 32,589 short tons valued at \$33,892,560, a decline of 14 percent from the 37,820 tons valued at \$39,332,800 recovered in 1943. The value in both years was computed at 52 cents a pound.

Of the 32,589 tons recovered, only 4,245 tons were in the form of metallic tin. Detinning plants produced 3,751 short tons of pig tin from tinplate clippings and old tin-coated containers, and 471 tons (tin content) of secondary pig tin and 23 tons of tin foil were produced at various plants from tin-base scrap and residues. The total recovery of unalloyed tin from scrap was 4,245 short tons in 1944, compared with 5,252 tons in 1943. Recovery of tin in solder, in tin-base babbitts, in lead-base alloys, and in brass and bronze all declined from the 1943 figures, but the recovery in tin compounds at detinners' plants increased. As was the case in previous years, almost half of the tin reclaimed was contained in brass and bronze scrap, and more than half of that recovered went into brass and bronze, reflecting the consumption of tin-base scrap directly in the manufacture of these alloys.

Secondary tin recovered in the United States, 1943-44, in short tons

Secondary tin recovered			Recoverable tin content of scrap		
Form of recovery	1943	1944	Kind of scrap processed	1943	1944
As metal:			New scrap:		
At detinning plants.....	4,327	3,751	Tin plate.....	2,591	2,654
At other plants.....	925	494	Tin-base.....	2,197	2,002
	5,252	4,245	Lead-base.....	1,708	732
			Copper-base.....	6,147	5,852
				12,643	11,240
In solder.....	6,588	4,892	Old scrap:		
In tin babbitt.....	3,112	2,448	Tin cans.....	1,986	1,447
In chemical compounds.....	250	350	Tin-base.....	4,795	4,487
In lead-base alloys.....	3,447	3,301	Lead-base.....	6,542	5,684
In brass and bronze.....	19,171	17,353	Copper-base.....	11,854	9,731
	32,568	28,344		25,177	21,349
	37,820	32,589		37,820	32,589

Babbitt scrap and tin scruff and dross were the only types of tin-base scrap to be found in greater quantity than in 1943, as the flow of such types as block tin pipe, pewter, and tin residues was retarded from the effects of the tin conservation program, the manufacture of most materials of high tin content having been curtailed early in the war. The program for treating excess type metal, by the National Lead Co., for the account of Metals Reserve Company, was continued only through February, with 5 tons of tin reclaimed from this source in 1944.

The supply of all types of tin-base scrap was short, and ceiling prices prevailed throughout the year. The requirement of surrendering a used collapsible tube when each new tube of toilet preparations was purchased was rescinded on March 1, 1944, owing to the very low tin content of tubes manufactured during the collection period. Tin-reclamation operations on old tubes at the Government-owned plant of the Tin Salvage Institute were completed by the end of the year. In the salvage program carried out by this plant during

the 2 years and 8 months of activity, 4,494 tons of tubes were re-
ceived, and metal reclaimed amounted to 2,997 tons of alloys con-
taining 1,022 tons of tin, 1,928 tons of lead, and 47 tons of other
metals.

*Consumption of purchased tin scrap in the United States in 1944, gross weight,
in short tons*

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Block-tin pipe, scrap, and foil.....		637	29	41	707
Tin scrap and dross.....	3,080				3,080
Pewter.....		144			144
Tin babbitt.....		4,397	22	19	4,438
Residues.....	243				243
	3,323	5,178	51	60	8,612

Endeavoring to ease the critical tin situation, the War Production Board issued several amendments to General Preference Order M-43 during the year. The two most important amendments were that of June 6, which permitted raising the tin content of solder to a point where the product could be used effectively, and that of December 30, which struck at the black market uses of tin, particularly in costume jewelry, by prohibiting the purchase of certain products for resale after December 30, 1944, and the sale of these articles after March 1, 1945.

*Consumers' stocks of purchased tin-base scrap in the United States at end of year,
1943-44, gross weight, in short tons*

Scrap item	On hand—	
	Dec. 31, 1943	Dec. 31, 1944
Unalloyed tin.....	66	81
Tin-base alloys.....	420	481
Drosses and residues.....	1,473	784
	1,959	1,346

¹ Revised figures.

Quotations for dealers' buying prices of block-tin-pipe scrap at New York continued at 45.5 cents a pound throughout 1944, the same average as in the two previous years. The reports of scrap-metal dealers showed the shipment of only 1,262 tons of tin babbitt and pewter, and 155 tons of block-tin pipe to consumers during 1944, indicating that most shipments of tin scrap went directly to consumers from industrial sources. Imports of tin dross amounted to only 48 long tons in 1944 and 21 tons in 1943, compared with exports of tin dross and other tin-base scrap of 3,157 and 1,798 tons in the same 2 years.

Detinning plants.—During 1944, eight detinning plants were in operation: Johnston & Jennings Co., Metal & Thermit Corp. (three plants), Standard Metal Refining Co., Vulcan Detinning Co. (two plants), and a new plant in Birmingham, Ala.—the Southern Detinning Co. As was the case in 1943, these plants had a capacity for

handling a far greater tonnage of tin-plate clippings and used cans than was available for processing, so that nothing was lost by the cancellation in 1943 of the ambitious detinning-plant construction program.

Secondary tin recovered at detinning plants in the United States, 1943-44

	1943	1944
Scrap treated:		
Clean tin plate.....long tons..	206, 336	227, 220
Old tin-coated containers.....do..	175, 870	146, 976
	382, 206	374, 196
Tin recovered from new tin-plate clippings.....short tons..	2, 591	2, 654
Tin recovered from old tin-coated containers.....do..	1, 986	1, 447
	4, 577	4, 101
Tin recovered as metal.....short tons..	4, 327	3, 751
Tin recovered in compounds.....do..	250	350
	4, 577	4, 101
Weight of tin compounds produced.....short tons..	537	774
Average quantity of tin recovered per long ton of clean tin-plate scrap used pounds..	25. 12	23. 36
Average quantity of tin recovered per long ton of old tin-coated containers used pounds..	22. 58	19. 68
Average delivered cost of clean tin-plate scrap.....per long ton..	\$16. 62	\$14. 72
Average delivered cost of old tin-coated containers.....do..	\$13. 88	\$14. 12

In spite of the efforts of salvage agencies to promote more effective collection of old cans and the issuing of amendments to Conservation Order M-325 (restricting sales to other types of consumers and strengthening collection methods), the public response in the form of washed and flattened cans, ready for shipment, was disappointing. The amount of old cans treated by detinners fell from 175,870 long tons in 1943 to 146,976 tons in 1944, a decline of 16 percent. This loss was only partly offset by a slight gain in the tonnage of new tin-plate clippings processed. It is interesting to note that over 40,000 tons of prepared cans were shipped to detinners from Army posts, camps, and stations during 1944 or about 27 percent of the total amount treated.

Further declines in the average quantity of tin recovered per long ton of scrap were registered in 1944, due to substitution of electroplating for hot dipping of tin plate and to the use of lacquered and "bonderized" metal in many cans instead of tin plate. The average recovery of tin from new clippings declined from 25.12 pounds per long ton in 1943 to 23.36 pounds in 1944, and the recovery from old cans dropped from 22.58 pounds per long ton of cans treated in 1943 to 19.68 pounds in 1944.

Imports of tin-plate scrap in 1944 totaled 17,323 long tons, compared with 19,577 tons in 1943. Exports of tin-plate scrap, circles, waste-waste, and clippings rose to 4,435 long tons, contrasted with the comparatively low figure of 1,740 tons in 1943.

SECONDARY ANTIMONY

Secondary antimony recovered from lead- and tin-base scrap totaled 15,886 short tons valued at \$5,032,685 in 1944, a gain of less than 3 percent over the 15,483 tons valued at \$4,929,787 recovered during 1943. The value was computed at 15.84 cents a pound in 1944 and 15.96 cents a pound in 1943—the average selling prices for ordinary American-brand antimony in the 2 years at New York.

Secondary antimony recovered in the United States, 1943-44, in short tons

Secondary antimony recovered			Recoverable antimony content of scrap		
Form of recovery	1943	1944	Kind of scrap processed	1943	1944
Antimonial lead.....	9,255	10,894	New scrap:		
Other lead alloys.....	5,444	4,643	Lead-base.....	62	327
Tin-base alloys.....	784	349	Tin-base.....		1
Purchased alloys.....				62	328
	15,483	15,886	Old scrap:		
			Lead-base.....	15,109	15,255
			Tin-base.....	312	303
				15,421	15,558
				15,483	15,886

The principal source of recoverable antimony in 1944, as in the past, was old battery plates. Remelters and smelters recovered 7,757 tons of antimony from this source during the year, an increase of more than 7 percent over the 7,215 tons reclaimed in 1943. The quantity of antimony recovered in antimonial lead increased from 9,255 tons in 1943 to 10,894 tons in 1944, but recovery of antimony in other lead- and tin-base alloys declined. This was due to two principal causes: The continued demand for antimonial lead for such purposes as replacement battery parts and the fact that the antimony content makes it desirable to process antimonial lead scrap back to antimonial lead, even when processed in primary lead plants. Almost 98 percent of the secondary antimony recovered in 1944 was reclaimed by remelters, smelters, and refiners and the other 2 percent by bearing manufacturers. Consumption of purchased scrap from which antimony was recovered may be found in the tables on consumption of lead-base and tin-base scrap in the sections of this chapter devoted to those metals, products in which antimony was recovered being included in the lead- and tin-products table. As far as could be determined, all antimony recovered from scrap remained in the alloyed state, none being regained as unalloyed metal or in chemical compounds.

All limitation on the antimony content of alloys had been removed in March 1943, and antimony was on the "free" list during all of 1944. However, owing to demand for antimony oxide for flameproofing, the supply of primary antimony became low by the end of the year, and allocations were reimposed early in 1945.

The ceiling price for antimony in alloy metals or metallic scrap, after having been last adjusted in April 1942, remained at 15.50 cents a pound of contained antimony. There was no regulation of prices for antimony in drosses, probably because of the small volume of this material that actually changed hands, since antimony skimmings collected in such processes as lead refining were retained until a sufficient quantity accumulated to justify making a "run" of antimonial lead. The maximum price for standard grade antimony remained 14.50 cents a pound at Laredo, Tex.

SECONDARY ZINC

Secondary zinc recovered in 1944 from purchased scrap and residues totaled 345,469 short tons with a value of \$59,420,668, calculated at

8.6 cents a pound, the average selling price for the year of all grade of refined zinc, not including bonuses paid by Metals Reserve Company. This total was 6 percent lower than in 1943, when 368,483 tons with a value of \$63,379,936 at 8.6 cents a pound were recovered

Secondary zinc recovered¹ in the United States, 1943-44, in short tons

Secondary zinc recovered			Recoverable zinc content of scrap		
Form of recovery	1943	1944	Kind of scrap processed ¹	1943	1944
As metal:			New scrap:		
By distillation:			Zinc-base	94,845	106,504
Slab zinc	47,791	48,582	Copper-base	189,414	125,765
Zinc dust	22,336	22,753	Aluminum-base	4	39
By remelting	8,765	8,178		284,263	232,308
	78,892	79,513			
In zinc-base alloys	4,808	6,826	Old scrap:		
In brass and bronze	253,082	222,383	Zinc-base	29,588	26,018
In aluminum-base alloys	96	9	Copper-base	54,637	87,143
In chemical products:				84,225	113,161
Zinc oxide (lead free)	5,375	7,076		368,488	345,469
Zinc sulfate	2,707	2,558			
Zinc chloride	11,104	11,117			
Lithopone	11,110	13,720			
Miscellaneous	1,314	2,267			
	289,596	265,956			
	368,488	345,469			

¹ Zinc content.

The over-all decrease was caused by a 13-percent decline in secondary zinc recovered in brass and bronze from brass scrap. In contrast to the recovery from brass scrap, secondary zinc reclaimed from zinc-base scrap was 8,089 tons greater than the 124,433 tons recovered in 1943 and 8,026 greater than was salvaged in 1942. The 1944 gain was achieved by the secondary zinc industry in spite of the fact that the wartime uses of zinc, other than in brass, were mostly of a nature that would dissipate the metal. Galvanizing, smoke screens, pigments, and corroding plates for ships and boilers are all applications from which no salvage is expected. Although the zinc recovered from all copper-base scrap in 1944 decreased, that reclaimed from old scrap increased to 87,143 tons from 54,637 tons in the previous year, mostly as a result of increased recovery from fired cartridge cases. The decreased recovery from new copper-base scrap was attributable to cut-backs in the brass-manufacturing program during 1944.

The important decreases in recovery of zinc in 1944, aside from that in brass and bronze, were 7 percent in remelt metal and 6 percent in zinc sulfate. The largest gains in recovery were in chemical products, zinc recovered from scrap in zinc oxide rising 33 percent over the amount for 1943 and that in lithopone showing a gain of 23 percent over the 1943 figure.

Secondary zinc recovered in zinc dust totaled 22,753 tons compared with 22,336 tons in 1943, and that in redistilled slab increased to 48,582 tons in 1944 compared with 47,791 tons in the previous year. Zinc dust made from scrap amounted to 88 percent of the total domestic dust production from all sources, whereas the production of zinc oxide from scrap was only 6 percent of the total zinc oxide production from all sources. Most zinc dust is distilled from scrap in secondary plants, one reason for this being that the retorts used in

Smelting zinc from ore are too small and closely spaced to be conveniently used with the steel boxes employed for condensing zinc dust. The scrap was distilled at 21 smelters in 1944. Of these, 5 made both distilled slab and zinc dust, 12 made slab only, and 4 produced dust with no slab. Three plants that had produced slab in 1943 distilled scrap in 1944, and 1 1943 zinc-dust producer had no dust production in 1944.

Production of secondary zinc and zinc-alloy products in the United States, 1943-44, gross weight, in short tons

Product	1943	1944
Distilled slab zinc.....	48,215	49,037
Zinc dust.....	22,788	26,511
Spelter.....	7,406	7,741
Die-cast slab.....	2,611	3,760
Die-cast and die-casting alloys.....	2,617	1,786
Working stock.....	591	594
Waste zinc.....	909	1,737
Secondary zinc in chemical products.....	31,610	36,738

¹ Contains small tonnages of zinc anodes.

Secondary zinc recovered at 42 chemical plants in 1944 totaled 36,624 tons compared with 31,610 tons in the previous year. The chief increases were 2,610 tons in lithopone and 1,701 tons in lead-free zinc oxide. Secondary zinc recovered in miscellaneous chemicals including zinc carbonate increased 953 tons in 1944.

In addition to the chemical plants and distillers, 98 remelters, including brass-ingot makers, zinc smelters and scrap-metal dealers, and 107 foundries and other manufacturers consumed purchased zinc scrap in 1944.

Consumption of purchased zinc scrap in the United States in 1944, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Crippings.....	4,063	.....	3,974	.....	8,037
Sheet and strip.....	.....	5,584	.....	269	5,853
Engravers' plates.....	.....	2,236	.....	65	2,301
Scumming and ashes.....	39,605	.....	25,297	.....	64,902
Dross.....	48,605	.....	8	.....	48,613
Die castings and other alloyed zinc.....	2,854	8,010	147	69	11,080
Flue dust and residues.....	13,809	14,414	19,086	10,965	58,214
	108,936	30,244	48,512	11,308	199,000

Zinc-base scrap consumption totaled 199,000 tons in 1944, 13,248 tons more than in 1943, the greatest increases being in flue dust and chemical residues whose use rose to 58,214 tons from 47,725 tons in the previous year, and in dross, treatment of which increased to 48,613 tons from 43,894 tons in 1943. Total metallic zinc scrap consumption decreased to 27,271 tons from 29,796 tons in the previous year.

Consumption of zinc residues exhibited a rising trend through the first half of 1944, reaching a peak in July, after which monthly consumption fell for the remainder of the year. Consumption of metallic scrap varied from month to month during 1944, but there was no

definite upward or downward trend. Most metallic zinc scrap was handled by scrap-metal dealers, whereas most of the drosses and residues moved directly from generators to smelters or chemical works. The scrap market for zinc solids was rather inactive owing to lack of labor, shortage of transportation, and in many industrial areas a winter of exceptionally heavy snowfall, which further impeded collection and transportation of scrap.

Shipments of zinc scrap to consumers by nonferrous scrap-metal dealers during 1944 totaled 42,771 tons, a decrease of 1,712 tons from the 1943 total of 44,483 tons and 15 percent below the 1942 figure of 50,435 tons. The monthly total of shipments fluctuated from the low point of 3,051 tons in February to a high of 3,968 tons in June, then to the year's low point of 2,981 tons in December. Dealers' stocks, with slight variations, climbed steadily from 5,344 tons on January 1 to 6,744 tons at the end of the year.

Of the total zinc-base scrap treated, 14 percent was in metallic form, the remainder being drosses and residues, but 69 percent of the zinc recovered from both of these classes of scrap emerged in metal products and only 31 percent in chemical form. One reason for the high percentage of metal products is the facility with which galvanizers' dross, one of the big residue items, can be treated by distillation to yield slab zinc or zinc dust. Another is the practice of some smelters of mixing flue dust with ore in distillation operations.

The amount of zinc drosses and residues made is a function, not of the demand for the residue but of the demand for the products in whose manufacture the residues are generated. Consumption of scrap equals the amount generated plus or minus changes in stocks so that ordinarily, in the secondary zinc industry, high consumption of zinc residues accompanies expanded galvanizing operations, which generate dross, expanded brass-ingot production, which generates zinc oxide flue dust, and expanded sodium hydrosulfite manufacture, which generates zinc-base chemical residues. Studies of the ratio between slab-zinc consumption and zinc-residue consumption have borne out the above conclusion.

Consumers' stocks of purchased zinc-base scrap in the United States at end of year 1943-44, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1943	Dec. 31, 1944
Metallic zinc scrap	3, 574	2, 222
Dross	6, 579	7, 475
Skimmings and residues	27, 485	20, 164
	37, 638	29, 861

The zinc supply situation on the first of the year was such that the War Production Board began relaxing some of the controls on the uses of zinc. Restrictions were modified a dozen times during the year so that the number of items for which zinc could be used without restriction continually increased. On February 22 remelt zinc was removed from allocation, and deliveries of zinc scrap were allowed without restriction. Use of all monthly zinc allocation certificates was discontinued on September 15. However, all these relaxations did not

case much of a rise in the consumption of zinc for civilian purposes; that use was limited by other factors, such as lack of steel for galvanizing.

Ceiling prices for secondary slab zinc remained the same as in 1943, the price for Prime Western zinc being 8.25 cents a pound. Maximum prices for zinc scrap also remained unchanged, with new clippings at 7.25 cents a pound and old zinc at 5.75 cents. Dealers' buying prices for new zinc clippings at New York averaged 5.81 cents per pound during 1944, a slight decrease from the monthly average of 5.88 cents in 1943 and 0.64 cent less than the 1942 figure of 6.45 cents. The year began with this material quoted at 5.62 cents, and the quotation reached 5.87 cents by April, where it remained until the close of the year. Dealers' buying prices for old zinc scrap had a monthly average of 4.31 cents per pound, compared with 4.12 cents in 1943 and 4.65 cents in 1942.

Imports of old zinc scrap into the United States totaled 186 tons in 1944 compared with 114 tons in 1943. Imported drosses and residues totaled 4,694 tons in 1944, a decrease of 338 tons from the 5,032 tons received from abroad in 1943. Large quantities of fume from a primary smelter in Canada were imported by one company for the manufacture of zinc sulfate and lithopone, but the zinc reclaimed from this material was not counted as secondary zinc.

MAXIMUM PRICES FOR CERTAIN SCRAP METALS

COPPER AND BRASS SCRAP

(Set by O. P. A.; effective Jan. 25, 1944)

The following are maximum prices, f. o. b. freight cars, trucks, or other means of transportation at the point of shipment and include all commissions and service charges:

Item No.	Grade of scrap	Maximum price per pound of material (cents)
1.	No. 1 copper wire and No. 1 heavy copper	9.75
1.	No. 1 tinned copper wire and No. 1 tinned heavy copper	9.75
1.	No. 2 copper wire and mixed heavy copper	8.75
1.	Copper tuyeres	8.75
1.	Light copper	7.75
1.	No. 1 copper borings	8.75
1.	No. 2 copper borings	7.75
1.	Lead covered copper wire and cable	(1)
1.	Insulated copper	(1)
2.	Bell metal	15.50
2.	High grade bronze gears	13.25
2.	High grade-low lead bronze solids	(3)
2.	High grade bronze solids	(3)
2.	High grade-low lead bronze borings	(3)
2.	Babbitt lined brass bushings	13.00
2.	High lead bronze solids	(3)
2.	High lead bronze borings	(3)
2.	Red trolley wheels	10.75
2.	Tinny bronze (phosphor bronze) solids	10.50
2.	Tinny bronze (phosphor bronze) borings	10.50
2.	Copper nickel solids and borings	9.25
2.	Bronze paper mills wire cloth	9.50
2.	Aluminum bronze solids	9.00
2.	Soft red brass (No. 1 composition)	9.00
2.	Soft red brass borings (No. 1 composition borings)	9.00
2.	Contaminated gilding metal solids	8.50
2.	Contaminated gilding metal turnings	8.50
2.	Unlined standard red car boxes	8.25
2.	Lined standard red car boxes	7.75
2.	Cocks and faucets	7.75
2.	Mixed brass screens	7.75
2.	Red brass breakage (irony composition)	7.50
2.	Old nickel silver solids	6.25
2.	Old nickel silver borings	6.25
2.	Yellow brass castings	5.25
2.	Copper-lead solids	5.56

See footnotes at end of table.

Item No.	Grade of scrap	Maximum price per pound of material (cents)
2.	Copper-lead borings.....	5.50
2.	Automobile radiators.....	7.00
2 or 3.	Yellow brass castings.....	6.25
2.	Zincy bronze solids.....	8.00
2.	Zincy bronze borings.....	8.00
3.	Fired rifle shells.....	8.25
3.	Brass pipe.....	7.50
3.	Old rolled brass.....	7.00
3.	Admiralty condenser tubes.....	7.50
3.	Muntz metal condenser tubes.....	7.00
3.	Plated rolled brass sheet, pipe and reflectors.....	6.50
3.	Manganese bronze solids (0.4% Pb or less).....	7.25
3.	Manganese bronze solids (0.41% to 1% Pb).....	6.25
3.	Manganese bronze borings.....	6.50
4.	Refinery brass (over 60% Cu).....	(7)
4.	Refinery brass (50.01% to 60% Cu).....	(8)

¹ (a) Multiply gross weight, less weight of lead covering and any insulation by price for applicable grade of copper wire; (b) divide result by gross weight; and (c) deduct from resulting quotient 0.15¢. This is maximum price. In addition payment may be made for lead covering at maximum price established by MPR 70. Maximum price may be determined by applying foregoing to representative sample.

² (a) Multiply gross weight less weight of insulation by price for applicable grade of copper; (b) divide result by gross weight; and (c) deduct from resulting quotient 0.15¢. This is maximum price. Maximum may be determined by applying foregoing computation to representative sample.

³ Price shall be determined by application of section 16 (a) (3) of MPR 20 to analysis, other than by inspection, of material. If consumer receives less than 5,000 pounds in a shipment, he may determine by inspection that material meets specifications but in such case the maximum is 10.75¢. High grade-low lead bronze solids which, except for the copper content or the tin content, or both, meet the specification and which, except for form, meet the specification for high grade-low lead bronze borings, may be priced as high grade-low lead bronze borings. In either case, price is subject to 1% reduction for each 7% of dirt, etc.

⁴ Price shall be determined by application of Section 16 (a) (3) of MPR 20 to wet or natural analysis after button analysis has determined proper classification. If consumer receives less than 5,000 in a shipment at one time, he may determine by inspection that material meets specification but in such case maximum is 10.00¢ subject to 1% deduction for each 1% of dirt, etc.

⁵ Maximum shall be calculated by application of following method to analysis other than by inspection

1.25% Zn or less: Cu content x 9.25¢ + Sn content x 33¢

1.26% to 4% Zn: Cu content x 9¢ + Sn content x 32¢

4.01% Zn or more: Cu content x 8.5¢ + Sn content x 30¢

However, 0.01¢ per pound of material shall be added or deducted for each 0.01% antimony below 0.25% or above 0.75%. If consumer receives less than 5,000 pounds in a shipment at one time he may determine by inspection that material meets specifications but in such case maximum is 9.50¢. High lead bronze solids which, except for the copper content or the tin content, or both, meet the specification for high lead bronze borings may be priced as high lead bronze borings. In either case, price is subject to 1% deduction for each 1% of dirt, etc.

⁶ Apply same method as for high lead bronze solids to wet or natural analysis after button analysis has determined proper classification of zinc content. If consumer receives less than 5,000 in a shipment at one time, he may determine by inspection that material meets specifications but in such case maximum is 8.5¢ subject to 1% deduction for each 1% of dirt, etc.

⁷ 60.01% dry copper content (61.31% wet assay) times 8.00¢.

⁸ 50.01% dry copper content (51.31% wet assay) times 7.75¢.

QUANTITY PREMIUMS

(i) For shipment at one time of 60,000 pounds or more of only one item other than Item 4—3¢ per pound;

(ii) For shipment at one time of 40,000 pounds or more of one or two items—1½¢ per pound;

(iii) For the shipment by one person in one railroad car of 60,000 pounds or more of material eligible for the 0.75 cent per pound premium provided for in subdivision (i) of this paragraph and, in the same railroad car, 20,000 pounds or more of any one other group—0.50 cent per pound for the material composing such other group in addition to 0.75 cent per pound for the 60,000 pound group.

No quantity premium may be added if any special use, briquetting or crucible shape premium has been added to such price.

BRIQUETTING AND CRUCIBLE SHAPE PREMIUMS

No. 1 copper wire and No. 1 heavy copper..... 14¢

No. 1 tinned copper wire and No. 1 tinned heavy copper..... 14¢

No. 2 copper wire and mixed heavy copper..... 1¢

Copper borings..... 15¢

Manganese bronze solids..... 21¢

All other copper alloy scrap..... 14¢

Above premiums not applicable on sales to copper refiner or brass and bronze ingot manufacturer.

SPECIAL USE PREMIUMS

To the maximum price of any grade of copper scrap a special use premium of 14¢ may be added if the material has been prepared to meet the consumer's specifications and is suitable for direct use without further preparation. Not applicable on sales to refinery, ingot maker, foundry or brass mill.

No special use, briquetting or crucible shape premium may be added if any quantity premium has been added.

BRASS-MILL SCRAP

Revised to Oct. 29, 1942, by O. P. A. (f. o. b. shipping point)

	Heavy Scrap	Rod Ends	Turn- ings
Copper.....	10¼	10¼	9¼
Used copper.....	9¾	9¾	9¾
Commercial bronze:			
90% or more Cu.....	9¼	9¼	8¾
90% to 95% Cu.....	9¾	9¼	8¾
Red brass: 80% or more Cu.....	9¼	8¾	8¾
Best quality brass: 71% to 80% Cu.....	8¾	8¼	8
Y-cow brass.....	8¾	8¾	7¾
Muntz metal.....	8	7¾	7¼
Nickel silver:			
50% Ni.....	9¼	9	4¾
100% Ni.....	10¼	9¾	5¼
15% Ni.....	10¾	10¾	5¼

Maximums are for shipments of less than 15,000 pounds. For 15,000 to 40,000 pounds add 0.62½¢ but heavy scrap may not be mixed with rod ends and/or turnings. For over 40,000 pounds add 1.00¢ for any mixture.

ZINC SCRAP

Established Oct. 17, 1941, by O. P. A. (per lb. f. o. b. point of shipment)

(Prices are for clean, dry scrap, free of iron and other foreign material)

New zinc clippings and trimmings.....	7.25¢
Engravers' and lithographers' plates.....	7.25¢
Old zinc scrap.....	5.75¢
Unsweetened zinc dross.....	5.80¢
Die cast slab.....	5.80¢
New die cast scrap.....	4.95¢
Radiator grilles, old and new.....	4.95¢
Old die cast scrap.....	4.50¢

Premium of 0.50¢ per pound allowed for shipments at one time of 10,000 pounds of new zinc clippings, engravers' and lithographers' plates and old zinc scrap or any combination of the three; and for shipment at one time of 20,000 pounds of new or old die cast scrap and radiator grilles or any combination of the three. No premium is allowed on galvanizers' dross or die-cast slab.

ALUMINUM SCRAP

*Revised to Dec. 23, 1943, by O. P. A. (f. o. b. shipping point)**Following are the maximum prices for aluminum scrap (in cents per pound):*

	I Lots of under 1,000 lb.	II Lots of 1,000 to 30,000 lb.	III Lots of 30,000 lb. or more
1. Plant scrap, segregated:			
Solids:			
All 8-type alloys except 28.....	8½	9½	10
28.....	8	9	9¼
High-grade alloys.....	7	8	8½
Low-grade alloys (Includ. No. 12 and piston alloys).....	6½	7½	8
Borings and turnings:			
High-grade alloys (Includ. all 8-type).....	5½	6½	7
Low-grade alloys (Includ. No. 12 and piston alloys).....	5	6	6½
2. Plant scrap, mixed:			
All solids.....	6	7	7½
Borings and turnings.....	4	5	5½
3. Obsolete scrap:			
Pure cable.....	8	9	9¼
Old sheet and utensils (98% minimum aluminum).....	7	8	8¼
Old castings and forgings.....	6½	7	7¼
Pistons free of struts.....	6½	7	7¼
Pistons with struts.....	4½	5	5¼
Old alloy sheets.....	5½	6	6½
4. Wrecked aircraft (prepared):			
90% plus aluminum alloy content.....			7
70-90% aluminum alloy content.....			6
50-70% aluminum alloy content.....			4
Per pound of aluminum alloy recovered, irrespective of quantity. In the case of wrecked aircraft, and of drosses, skimmings, grindings, sweepings, and spatters, the maximum prices established for such scrap are delivered to the buyers' receiving point.			
5. Drosses, skimmings, grindings, sweepings, sawings, spatters:			
50% plus aluminum.....			5¼
Under 50%.....			4¼

Per pound of aluminum contained, irrespective of quantity, as determined by fire assay or hydrogen evolution. In the case of wrecked aircraft, and of drosses, skimmings, grindings, sweepings, and spatters, the maximum prices established for such scrap are delivered to the buyers' receiving point.

6. Aluminum foil scrap:

Aluminum foil scrap or light gauge aluminum sheet which does not exceed 0.006 of an inch in thickness; clean, free of paper, gutta-percha or any other adhering substances or forms of contamination—16 cents per pound of material, irrespective of quantity. Contaminated aluminum foil scrap not conforming to these specifications shall be bought and sold for not more than a price, below the maximum price for clean aluminum foil scrap, fairly reflecting the value of such scrap.

Note 1. Meaning of terms. "Plant scrap" means scrap generated in the course of fabrication or manufacture and includes new material or parts rejected or discarded because defective, damaged in processing, part of surplus or idle inventory, or otherwise unfit for use. The mean plant scrap generated by shearing, clipping, cutting, blanking, or similar process, also defective or rejected wrought aluminum parts, defective or rejected castings, and gates, sprues, risers, or similar foundry scrap. Scrap shall not be deemed "segregated", whether in the form of solids or in the form of borings, turnings or other machinings, unless it consists of one alloy only and is so identified and handled as to be accepted for reprocessing into aluminum of the original alloy specifications without the necessity for other than routine examination by the processor. The supplier must deliver to the buyer Segregation Certificate PD-706 showing alloy number and specification, and that scrap meets the specification. "Segregation low grade" scrap includes all alloys containing over 1% iron by weight (including free iron) except alloy PM 754. "Segregated S-type alloy solids" consist of scrap generated from the wrought or S-type alloys such as 17S or 24S. All segregated alloy solids which are not low-grade or S-type are "high-grade."

Note 2. Iron, oil, moisture, etc. If borings, turnings, and similar machinings or other grades of aluminum scrap contain oil, water, or other forms of contamination, maximum prices may be paid only on basis of actual weight of aluminum or aluminum alloy contained. If aluminum or aluminum alloy content by weight is less than 85% of weight of material, buyer may only pay delivery charges on that portion of weight of material represented by weight of aluminum or aluminum alloy content.

Note 3. Quantity differentials. The requisite quantities for which premiums are provided in columns II and III, may consist of various grades of aluminum scrap, but other metals may not be included for the purpose of making up such quantities.

In computing the weight necessary to obtain a quantity differential, the actual weight of the material at the point of shipment, as determined by the public carrier, or as certified to and accepted by the public carrier, or as certified by a public weigher, is to be used. If the weight of the material at the point of shipment is not determined by any of the methods herein specified, the actual weight of the material at the buyer's receiving point shall be used.

Note 4.—Revoked.

Note 5. Wrecked aircraft (prepared). Maximum prices are for actual aluminum alloy content of ingot recovered by the buyer's first melt of the entire shipment. By mutual agreement of buyer and seller, 20% of shipment by weight may be used as representative sample in determining amount of aluminum alloy recovered. Where less than 10,000 pounds are received at one time the buyer may estimate the amount of aluminum alloy which will be recovered and make settlement on the basis of that estimate.

Note 6. Premiums for special preparation. (a) Upon the sale of segregated solid aluminum plant scrap of any of the wrought aluminum or S-type alloys, except 2S and 3S, to the Aluminum Company of America, the Olin Corporation, or the Reynolds Metals Company, the following premiums may be charged, demanded, paid, or offered.

	Premium (cents per pound)
Baled or packaged, for briquetting.....	1/4
Briquetted or in large pieces too heavy to briquet.....	1

(b) Upon the sale of wrecked aircraft, prepared, a premium of one-half cent per pound of material may be charged, demanded, paid, or offered if such scrap is baled by compression or briquetted.

(c) The maximum price charged for aluminum scrap specially prepared or processed in any other manner shall be a price hereafter established in writing by the Office of Price Administration. The price so established shall be a price in line with the general level of prices established by this Maximum Price Regulation No. 2, taking into account the buyer's special requirements and the additional cost to the seller in preparing material to meet the buyer's requirements.

IRON AND STEEL SCRAP¹

By EDWIN K. JENCKES, HERBERT L. CULLEN AND ANTHONY P. DUDASH

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GENERAL SUMMARY

The demand for iron and steel scrap continued high in 1944. The total consumption was only slightly less than the peak recorded in 1943, as a 1-percent rise in the use of home scrap was offset by a 2.6-percent decline in the consumption of purchased scrap. Because of the shortage of merchant scrap, consumers' stocks were drawn upon heavily, and a 25-percent reduction resulted. There was some increase in inventories of purchaseable scrap, but the net decline in total stocks of all types of scrap was 17 percent.

The slight reduction in iron and steel scrap consumption was accompanied by a small rise in the output of steel ingots and castings. Monthly production of the latter reached an all-time peak in March 1944 and for the first 7 months of the year exceeded the output in the corresponding months of 1943. In the late summer and fall, over-optimism regarding the outlook for termination of the war in Europe was reflected in lower production rates, so that the net increase in steel production for the year was less than 1 percent. Pig-iron production followed a similar pattern, the net gain for the year being 0.3 percent, and the last 5 months of the year showed lower tonnages than the corresponding months of the preceding year.

Consumption of scrap was fairly uniform throughout the year and responded to monthly steel-production rates that varied between the relatively narrow limits of 93 and 99 percent of capacity. The high point of the year was in March, when 5.4 million net tons were consumed. This compares with the previous year's maximum in October of 5.4 million tons and with the all-time high in October 1941 of 5.6 million tons.

The average steel-furnace charge in 1944 did not differ from that in 1943, in each year 47 percent of the ferrous raw materials was scrap and 53 percent was pig iron. There was, however, some change with reference to iron furnaces, which in 1944 used 64 percent of scrap and 36 percent of pig iron as compared with 66 and 34 percent, respectively, in 1943.

¹ Minerals Yearbook, 1939, p. 513, gives definitions of the various scrap terms used in this report.

Of the total scrap used for all purposes in 1944, 59 percent was home and 41 percent purchased, as against 58 and 42 in 1943 and 56 and 44 in 1942. This trend shows clearly the effects of the progressive depletion in recent years of available supplies outside the hands of manufacturers and indicates the increasing difficulties under which the suppliers and dealers have been operating.

Salient statistics of ferrous scrap and pig iron in the United States, 1943-44

	1943	1944	Change in 1944 (percent)
Stocks, December 31:			
Ferrous scrap and pig iron at consumers' plants:	<i>Short tons</i>	<i>Short tons</i>	
Home scrap.....	1,668,103	1,435,056	-14
Purchased scrap.....	4,204,148	2,983,663	-29
Pig iron.....	1,634,701	1,501,599	-8
	7,506,952	5,920,318	-21
Ferrous scrap at suppliers' yards and producers' plants:			
Prepared scrap.....	641,142	769,860	+20
Unprepared scrap.....	662,107	780,638	+18
	1,303,249	1,550,498	+19
Total stocks of ferrous scrap at consumers' and producers' plants and at suppliers' yards.....	7,175,500	5,969,217	-17
Consumption:			
Ferrous scrap and pig iron charged to—			
Steel furnaces: ¹			
Home scrap.....	29,088,371	29,422,868	+1
Purchased scrap.....	18,420,700	18,193,639	-1
Pig iron.....	53,759,354	54,104,677	+1
	101,268,425	101,721,184	-----
Iron furnaces: ²			
Home scrap.....	5,851,736	5,917,040	+1
Purchased scrap.....	6,969,188	6,467,220	-7
Pig iron.....	6,555,805	6,846,944	+4
	19,376,729	19,231,204	-1
Miscellaneous uses ³ and ferro-alloy production:			
Home scrap.....	96,981	86,441	-11
Purchased scrap.....	1,223,980	1,261,993	+3
	1,320,961	1,348,434	+2
All uses:			
Home scrap.....	35,037,088	35,426,349	+1
Purchased scrap.....	26,613,868	25,922,852	-3
Pig iron.....	60,315,159	60,951,621	+1
	121,966,115	122,300,822	-----
Ferrous scrap (total).....	61,650,956	61,349,201	-----
Imports.....	143,387	111,974	-22
Exports:			
Iron and steel.....	52,945	90,453	+71
Tin plate, waste-waste, circles, strips, cobbles, etc.....	1,949	4,966	+155
Average prices per gross ton:			
Scrap:			
No. 1 Heavy-Melting, Pittsburgh ⁴	\$20.00	\$19.26	-4
No. 1 Cast cupola ⁴	20.00	20.13	+1
For export.....	18.67	22.24	+19
Pig iron, f. o. b. Valley furnaces: ⁴			
Basic.....	23.50	23.50	-----
No. 2 Foundry.....	24.00	24.00	-----

¹ Includes open-hearth, bessemer, and electric furnaces.

² Includes cupola, air, Brackelsberg, puddling, crucible, and blast furnaces; also direct castings.

³ Includes rerolling, reforging, copper precipitation, nonferrous, and chemical uses.

⁴ Iron Age.

Three important War Production Board scrap regulations were issued in 1944. One had to do with the segregation and use of alloy-steel scrap, the second prescribed the proportion of scrap to be used in steel-furnace charges, and the third permitted the melting of certain grades of low-alloy scrap in heats of carbon steel. The alloy-scrap segregation order was renewed once during the year and withdrawn in the fall, with the warning that if its provisions were not carried out on a voluntary basis the order would be reinstated. The second order ultimately placed the percentages of scrap to be used in open-hearth furnaces at 52 percent and in electric furnaces at 65 percent.

Ceiling prices established in 1941 by the Office of Price Administration for the various grades of scrap continued to set the levels at which scrap changed hands until August 1944, when this price structure yielded to the over-optimism regarding the outlook for termination of the war in Europe. Low points for various grades of scrap were reached in October and November, after which prices rose but not to the ceiling levels. No. 1 Cast, however, remained at ceiling price throughout 1944.

Since Pearl Harbor exports of scrap have been insignificant; imports in 1944 were a minor factor. Comparing 1944 with 1943, exports increased 74 percent but imports declined 22 percent.

A 17-percent decrease in total stocks during 1944 was due to continued high rate of operation in the steel industry and to the depletion of purchasable supplies. The largest decrease was in purchased stocks in the hands of consumers.

Figure 1 shows consumption of purchased scrap and output of pig iron and steel ingots and castings from 1905 to 1944, inclusive.

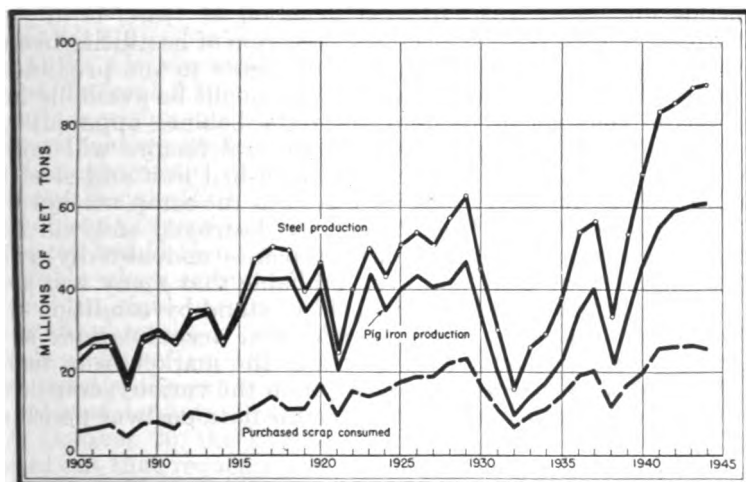


FIGURE 1.—Consumption of purchased scrap and output of pig iron and steel in the United States, 1905–44. Figures on consumption of purchased scrap for 1905–32 are from *State of Minnesota vs. Oliver Iron Mining Co. et al.*, Exhibits, vol. 5, 1935, p. 328; those for 1933–34 are estimated by authors; and those for 1935–44 are based on Bureau of Mines reports. Data on output of pig iron and steel are as given by the American Iron and Steel Institute.

POSTWAR OUTLOOK

Examination of the data on scrap and pig-iron consumption and steel-ingot and steel-casting production, as reported to the Bureau of Mines for 1937-43, discloses a number of ratios of remarkable uniformity from year to year; these ratios show a maximum deviation from the weighted mean for any year of less than 3 percent. Such an agreement over a period that includes years of recovery, recession, and wartime production offers a basis upon which to predict scrap usage if a satisfactory forecast of postwar steel production rates can be found. Of all such estimates, those furnished to the United States Senate by the Inland Steel Corp. and the U. S. Steel Corp., which are in substantial agreement with those of Walter Tower, seem to be the most acceptable.² These figures place the immediate postwar steel production at 65 to 70 million tons a year.

In addition to the scrap requirements of a 65- to 70-million-ton predicted steel output, allowance must be made for the requirements at iron furnaces. Fortunately the ratio of scrap and pig iron required in iron furnaces has a clearly defined relation to the requirements for steel furnaces, which permits estimation of the total scrap requirements for the entire industry. On this basis it may be expected that steel and iron furnaces (including an estimated steel-casting production not included in the Bureau of Mines published figures) will consume 45 to 49 million short tons of scrap and 44 to 47 million tons of pig iron in the immediate postwar years. It may also be expected that, of the scrap consumed, 54 to 57 percent will be home and 43 to 46 percent purchased scrap.

Since the ratio of scrap (both purchased and home) to ingot production has remained constant over a period of years, it might be expected that if an abrupt drop on the cessation of hostilities from the current annual rate of 90 million tons of ingots to the predicted 65 to 70 million tons occurs, an excess of scrap might be available in the United States that would tend to upset the balance apparent since 1937, especially if ruling prices drop. Several factors will militate against this result. For instance, much finished iron and steel that would ordinarily ultimately find its way into the scrap market when its utility had ceased has been physically destroyed and will never return to industry. Some war-purpose plants undoubtedly will be scrapped, but it is possible and even probable that many war plants and much equipment either will be held in stand-by condition or reconditioned for peacetime use. In addition, accumulations of old scrap, which normally find their way into the market from time to time, have been almost entirely cleared up in the various scrap drives. It is, therefore, even possible that the immediate postwar period will face a short supply of scrap.

PRICES

The average quoted price of Heavy-Melting steel, hydraulic compressed and bundled sheet at Pittsburgh was maintained at \$20 per gross ton (\$17.86 per short ton) between April 1941 and August 1944, then declined to a low of \$16.02 (\$14.31) in October and re-

² War Plant Disposal—Progress Report on the Preparation of Joint Hearings on the Disposal of Surplus Iron and Steel Plants and Facilities to be Held by the War Contracts Subcommittee and the Committee on Military Affairs of the U. S. Senate—April 23, 1946, pp. 6-7; and Walter Tower, President, American Iron and Steel Institute.

tered to \$19.89 (\$17.76) by December.³ The price for No. 1 Cast at \$21.29 (\$19.01) all year. Price for No. 2 Melting dropped from the January–August level of \$20 (\$17.86) to \$14.25 (\$12.72) in October, and recovered to \$19.53 (\$17.44) in December. Machine-shop turnings held uniformly at \$15 (\$13.39) until September, when the price began dropping, and reached a low of \$9.25 (\$8.26) in October; it recovered at \$12.91 (\$11.53) in December. Low-phos railroad specialties held until the end of August at \$23.23 (\$20.74), dropped as low as \$22.25 (\$19.87) in September and October, and then recovered to \$24.16 (\$21.57). The above prices are all Pittsburgh base.

A comparison of the quoted prices for Heavy-Melting scrap at Pittsburgh during the two war periods illustrates clearly how the "hold the line" order has prevented a run-away market in scrap. If for the First World War period the 1914 average is taken as 100 percent, the average yearly prices increased to 116 percent in 1915, 161 percent in 1916, 255 percent in 1917, and 252 percent in 1918. Similarly, considering the average 1939 prices as 100 percent, the average prices were 112 percent in 1940, 118 percent in 1941, 116 percent in 1942, 116 percent in 1943, and 112 percent in 1944.⁴

The price of basic pig iron (as quoted by Iron Age) at Valley furnaces remained at \$23.50 a long ton (\$20.98 a net ton) throughout the year and has been consistently at this level since December 1943.

WAR PRODUCTION BOARD ACTIONS DURING 1944

On January 13 the War Production Board issued Supplementary Order M-24-c permitting the melting of certain grades of low-alloy scrap in the production of carbon steel or iron and defined low-alloy steel scrap so used as (1) Cr or Cr-V scrap containing less than 1.65 percent Cr, (2) Cr-Mo scrap containing less than 0.27 percent Mo, and (3) Ni-Cr-Mo scrap containing less than 0.70 percent Ni, 0.60 percent Cr, and 0.30 percent Mo. The mixing of segregated scrap not falling within the scope of this order (except in the melting of steel) with other grades of scrap was prohibited. The requirement for the segregation of alloy-steel scrap was continued except that producers in quantities below certain fixed limits were excused.⁴ The trade did not expect that the use of these grades of alloy-containing steel scrap would be universally practicable and, in fact, it would not be possible where carbon steel must be alloy-free, or where it is manufactured to rigid specifications. This Board action was taken to relieve the shortage of carbon-steel scrap.

On September 7, 1944, Supplementary Order M-24-c was reissued, using exactly the same wording as the issue of January 13,⁵ because the order of January 13 had expired by limitation.

On October 26 the supplementary order was revoked.⁶ It was pointed out that revocation of this order and of Direction 4 to Order M-21-a (see below), which was revoked on the same date, did not mean that proper segregation of scrap and use of alloy scrap could be discontinued, and if these usages were not carried out on a voluntary basis controls would be reinstated.

On January 21, 1944, the Board issued⁷ a Direction under Supple-

³ American Metal Market, vol. 52, No. 1, January 3, 1945, p. 9.

⁴ Federal Register, vol. 9, No. 10, January 14, 1944, p. 571.

⁵ Federal Register, vol. 9, No. 179, September 7, 1945, p. 10980.

⁶ Federal Register, vol. 9, No. 215, October 27, 1945, p. 12865.

mentary Order M-21—a prescribing the use of 60-percent alloy scrap in the melting of alloy steel in electric-furnace charges and 50 percent in open-hearth charges, of which a minimum of 8 percent had to be turnings, including machine-shop turnings.⁷ It had been found⁸ that before this order the use of alloy scrap in melting alloy steel varied between 29 and 59 percent of the charge. The direction was for the purpose of relieving the demand for carbon scrap which was depleting stocks at an alarming rate. Some doubt was expressed as to the practicability of the order. In the light of a later direction, these fears seem to have been unfounded, since on September 13 Direction 4 to Order M-21-a was issued,⁹ increasing the percentage of alloy scrap to be used in electric furnaces to 65 percent and that in open hearths to 52 percent. Tungsten steels, stainless steels, and certain high-alloy heat-resisting steels were excluded from both directions. The Steel Industry Advisory Committee recommended that Direction 4 be kept in force to conserve alloys and reduce the contamination in carbon steel.

On October 26, Direction 4 was revoked (see comment above).¹⁰

In June 1943 the Board had prohibited the scrapping of serviceable automotive parts. This resulted in wreckers holding cars containing serviceable parts in their yards without immediate dismantling.

An amendment to Order M-311 clarified the original order and, in addition, permitted the scrapping of certain parts, so that cars could be dismantled and find their way quickly into the scrap market.

Other Board Action.—During the year various conferences, press releases, and similar publicity action were initiated by the War Production Board to keep the flow of scrap at the maximum level.

OFFICE OF PRICE ADMINISTRATION ACTIONS DURING 1944

On January 11 the Office of Price Administration issued Supplementary Order 82, effective January 13.¹¹ This supplementary order has the effect of relieving the War Department, the Navy Department, and Procurement Division of the Treasury from price-control regulations when selling scrap or waste metals to a dealer who in his turn will certify that the materials are for resale at not above OPA ceiling prices. The order also relieves Government agencies and their employees from civil or criminal liability resulting from the sale and delivery of materials under this supplementary order.

Amendment 14 to Revised Price Schedule 4, became effective February 19, 1944. This amendment established specific dollars-and-cents differentials to be applied to the maximum price of No. 1 Railroad Heavy-Melting steel scrap by railroads, car-manufacturing companies, and switching companies, which determined the ceilings for 35 grades of railroad-steel scrap. At the same time, specific maximum prices for seven listed grades of cast-iron scrap sold by railroads were announced. An increase from \$2:50 to \$3.50 per gross ton, or a specific increase of \$1 per gross ton, was allowed in the dealers' fee for preparing heavy breakable cast iron scrap into foun-

⁷ Federal Register, vol. 9, No. 16, January 22, 1944, p. 842.

⁸ American Metal Market, The Latest Scrap Order: Vol. 51, No. 20, January 28, 1944, p. 6.

⁹ Federal Register, vol. 9, No. 184, September 14, 1944, p. 11318.

¹⁰ Federal Register, vol. 9, No. 215, October 27, 1944, p. 12866.

¹¹ Federal Register, vol. 9, No. 7, January 11, 1944, p. 391.

dry sizes. On May 2 a further amendment to Revised Price Schedule 4 was announced by the OPA. This amendment had in part to do with the clarification of weights to govern rail shipments, vessel shipments, and imports of scrap.¹² Amendment 1 to MPR 4 effective November 16, 1944,¹³ authorized the addition of "established shipping charges" to the legal price for the point of shipment to the point of delivery to establish maximum delivered prices.

ALLOY-STEEL SCRAP

Throughout the year a marked tendency of purchasers to refuse alloy scrap was noted although clean carbon steel and iron scrap were in demand. One of the most extreme expressions of this sentiment was:¹⁴

It is reported that one large scrap user * * * has been a buyer of nickel turnings * * * at a reported price of \$5 per gross ton f. o. b. producer plant. These turnings, at the height of wartime demand, sold at better than \$19 f. o. b. shipping points.

During the year alloy scrap frequently was sold at far below ceiling prices, and alloy turnings and borings were particularly difficult to dispose of. In March it was reported in trade papers that of the approximately 2,000,000 gross tons of total scrap consumed, only about 100,000 tons were alloy. Since the alloy-steel production accounted for somewhat over 10 percent of the total steel produced, it can be seen how far this alloy-scrap consumption was out of line.

However, the large alloy-steel producers seem to be willing to purchase properly segregated scrap of their own manufacture and probably other brands of guaranteed analysis, particularly from steel consumers who have set up reliable mechanism for the proper segregation of scrap produced. This emphasizes further the necessity for continued segregation of scrap of known analysis mentioned in the paragraph on WPB actions above.

Unless this course is adopted and until simple methods of identification are worked out, it appears that a large volume of unsalable alloy scrap will accumulate and burden the scrap market for a long time to come. In view of the frantic efforts to obtain a sufficient supply of alloying elements in the early war years, it seems evident that methods should be developed to utilize the alloy content of the scrap.

Battlefield scrap.—During 1944 the War Department sold 142,162 long tons of overseas scrap at an average price of \$9.93 per ton in the United States. Since this material unquestionably contained little or no turnings, borings, or similar materials, the low price can be attributed in part to reluctance of the bidders to pay anything like ceiling prices for the material, much of which is heavily alloyed.

As a comparison, material offered by the Army at Medford, Mass.,¹⁵

¹² Federal Register, vol. 9, No. 87, May 2, 1944, p. 4599.

¹³ Federal Register, vol. 9, No. 227, November 14, 1944, pp. 13583-4.

¹⁴ American Metal Market, Pittsburgh Scrap Prices Reflect Firmer Tone: Vol. 51, No. 203, October 19, 1944, pp. 1-8.

¹⁵ American Metal Market, Additional Scrap Allotment Sought for New England: Vol. 51, No. 159, August 16, 1944, p. 7.

"auto scrap or truck scrap of one kind and another plus some structural scrap" was bought for \$10.37 a gross ton for heavy material, whereas only \$6 to \$8 was offered for tank scrap. Some users are reported to have refused to take any tank scrap. The problem of the ultimate disposal of the large quantities of heavily alloyed battlefield scrap only accentuates the general problem of the use of alloy scrap.

It is understood that the Army is concentrating on returning carbon scrap to this country and stocking alloy scrap in Europe.

STOCKS

On December 31, 1944, the supply of ferrous scrap in the hands of consumers, suppliers, and producers totaled 5,969,217 short tons, a 17-percent decline from the 7,175,500 tons on hand on December 31, 1943. This is the second year in succession when a loss in total stocks was experienced, the decline in 1943 being 7 percent.

The largest loss (over 1,000,000 short tons) was in purchased scrap in the hands of consumers. The magnitude of the demand for scrap is best illustrated by the fact that 25,900,000 tons of purchased scrap were consumed during the year. It is greatly to the credit of the scrap dealers that they could keep a steady stream of scrap flowing into the hands of consumers. No serious shut-down during the year for lack of scrap has been reported. Credit must also be given the consumers for arranging their operations in such manner as to keep a continuing supply of steel while facing such a marked decline in the immediately available supply of scrap.

CONSUMERS' STOCKS

Consumers' total home and purchased stocks on December 31, 1944, had decreased to 4,418,719 net tons or 25 percent from 5,872,251 tons at the beginning of the year. Stocks of home scrap (1,435,056 tons), had decreased by 14 percent and of purchased scrap (2,983,663 tons), by 29 percent.

Stocks of pig iron on December 31, 1944, amounted to 1,501,599 short tons, an 8-percent decrease from the 1,634,701 tons on hand on January 1.

These decreases of stocks in consumers' hands resulted from the continued high rate of steel and iron production. On the whole, the scrap industry in 1944 was able to supply the continued high demands to such good advantage that the stocks in consumers' hands were not too seriously depleted.

SUPPLIERS' AND PRODUCERS' STOCKS

Stocks in the hands of dealers, automobile wreckers, railroads, and manufacturers increased from 1,303,249 net tons on December 31, 1943, to 1,550,498 tons on December 31, 1944—a gain of 19 percent. This represents the largest year-end accumulation in the hands of suppliers since the close of 1940. Stocks held by dealers, railroads, and manufacturers increased by 26 percent, whereas the stocks of automobile wreckers decreased by 58 percent.

Consumers' stocks of ferrous scrap and pig iron on hand in the United States on Dec. 31, 1943, and Dec. 31, 1944, by States and districts, in short tons

State and district	Dec. 31, 1943				Dec. 31, 1944			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Pur- chased	Total		Home	Pur- chased	Total	
Connecticut.....	4,360	42,990	47,350	23,330	4,217	17,293	21,510	18,430
Maine.....	609	3,833	4,442	1,724	873	1,673	2,546	2,022
Massachusetts.....	19,678	66,974	86,652	65,124	12,712	46,690	59,402	89,753
New Hampshire.....	151	2,171	2,322	563	256	1,323	1,579	724
Rhode Island.....	1,272	9,966	11,238	4,065	1,191	5,961	7,152	3,639
Vermont.....	757	4,828	5,585	1,447	1,087	3,861	4,948	1,160
Total New England.....	26,827	130,762	157,589	96,253	20,386	76,801	97,187	115,728
Delaware.....	26,867	122,418	149,285	53,817	21,400	74,420	95,820	41,516
New Jersey.....	55,854	214,763	270,617	86,724	51,445	173,906	225,351	78,363
New York.....	620,478	723,743	1,344,221	391,672	627,521	467,610	1,095,131	329,087
Pennsylvania.....								
Total Middle Atlantic.....	703,199	1,060,924	1,764,123	532,213	700,366	715,936	1,416,302	448,965
Alabama.....	50,089	68,468	118,557	59,988	36,775	44,166	80,941	90,987
District of Columbia.....								
Kentucky.....	35,927	111,277	147,204	52,107	46,832	85,108	131,940	84,973
Maryland.....								
Florida.....	1,420	39,024	40,444	6,171	1,896	28,386	30,282	9,231
Georgia.....	29	420	449	209	49	421	470	349
Mississippi.....	263	2,696	2,359	1,591	245	1,750	1,995	2,793
North Carolina.....	434	5,397	5,831	1,049	1,886	5,262	7,148	2,138
Tennessee.....	9,730	61,706	71,436	18,366	4,779	42,549	47,328	23,442
Virginia.....	6,710	83,521	902,231	32,237	4,516	51,308	55,824	22,943
West Virginia.....								
Total Southeastern.....	104,602	372,609	477,111	171,718	96,978	258,950	355,928	186,856
Arkansas.....	1,153	24,245	25,398	970	1,059	18,683	19,742	1,580
Louisiana.....								
Oklahoma.....	3,871	48,778	52,649	3,114	8,103	64,629	72,732	19,525
Texas.....								
Total Southwestern.....	5,024	73,023	78,047	4,084	9,162	83,312	92,474	21,105
Illinois.....	131,593	426,382	557,975	154,391	111,436	353,420	464,856	134,746
Indiana.....	146,425	302,729	449,154	75,243	124,849	231,719	356,568	59,300
Iowa.....	3,063	31,847	34,910	7,689	1,789	36,310	38,099	17,920
Kansas.....	258	11,302	11,560	1,202	499	14,286	14,785	1,830
Nebraska.....								
Michigan.....	152,664	379,165	531,829	199,878	63,580	235,988	299,568	203,020
Wisconsin.....	11,331	40,612	51,943	8,438	13,009	72,812	85,821	14,893
Minnesota.....	8,280	102,214	110,494	17,301	4,324	88,429	92,753	8,693
Missouri.....								
North Dakota.....	1,687	135	1,822	71	1,333	151	1,484	54
South Dakota.....								
Ohio.....	315,306	755,985	1,071,291	266,558	186,416	424,936	611,352	206,890
Total North Central.....	770,607	2,050,371	2,820,978	730,771	507,235	1,458,051	1,965,286	647,355
Arizona.....	1,487	30,959	31,546	35	1,884	19,104	20,988	108
Nevada.....								
New Mexico.....								
Colorado.....	10,053	93,621	103,674	13,653	34,413	128,450	162,863	20,576
Utah.....								
Idaho.....	1	2,668	2,669	32	1	1,997	1,998	83
Wyoming.....	4		4	11	2		2	8
Montana.....	3,316	14,564	17,880	153	2,624	14,145	16,769	248
Total Rocky Moun- tain.....	14,861	140,912	155,773	13,884	38,924	163,696	202,620	21,023
Alaska.....								
Oregon.....	6,923	75,720	82,643	5,606	5,979	56,107	62,086	4,827
Washington.....								
California.....	36,060	299,927	335,987	80,172	56,076	170,810	226,886	55,740
Total Pacific coast.....	42,983	375,647	418,630	85,778	62,055	226,917	288,972	60,567
Total United States.....	1,668,103	4,204,148	5,872,251	1,634,701	1,435,056	2,983,663	4,418,719	1,501,599

Suppliers' stocks of iron and steel scrap on hand Dec. 31, 1943, and Dec. 31, 1944, by States and districts, in short tons

State and district	Dec. 31, 1943			Dec. 31, 1944		
	Prepared	Unpre- pared	Total	Prepared	Unpre- pared	Total
Connecticut.....	13,439	5,677	19,116	23,276	9,930	33,206
Maine.....	4,664	2,883	7,547	5,175	3,178	8,353
Massachusetts.....	20,760	22,852	43,612	29,392	25,983	55,375
New Hampshire.....	1,013	2,657	3,670	508	1,032	1,540
Rhode Island.....	1,969	1,619	3,588	2,498	2,070	4,568
Vermont.....	2,761	2,463	5,224	1,854	1,187	3,041
Total, New England.....	44,606	38,151	82,757	62,703	43,380	106,083
Delaware.....	955	1,124	2,079	1,022	1,400	2,422
New Jersey.....	21,110	17,091	38,201	22,114	16,842	38,956
New York.....	39,160	56,938	96,098	42,079	65,755	107,834
Pennsylvania.....	52,985	66,090	119,075	69,589	83,150	152,739
Total, Middle Atlantic.....	114,210	141,243	255,453	134,804	167,147	301,951
Alabama.....	7,543	11,998	19,541	15,839	24,916	40,755
District of Columbia.....	1,094	1,063	2,157	825	680	1,505
Florida.....	6,134	2,326	8,460	5,505	6,190	11,695
Georgia.....	8,892	12,511	21,403	9,888	15,952	25,840
Kentucky.....	10,324	6,164	16,488	12,673	7,845	20,518
Maryland.....	13,782	13,446	27,228	10,135	21,011	31,146
Mississippi.....	2,092	4,131	6,223	3,600	4,053	7,653
North Carolina.....	8,957	3,628	12,585	8,522	4,575	13,097
South Carolina.....	6,385	3,322	9,707	8,512	3,808	12,320
Tennessee.....	13,306	16,825	30,131	14,208	18,611	32,819
Virginia.....	7,432	7,947	15,379	10,163	15,317	25,480
West Virginia.....	6,964	5,979	12,943	10,748	6,343	17,091
Total, Southeastern.....	92,905	89,340	182,245	110,518	129,301	239,819
Arkansas.....	1,783	6,955	8,738	1,513	2,609	4,122
Louisiana.....	6,353	8,143	14,496	7,177	10,276	17,453
Oklahoma.....	4,819	7,936	12,755	4,196	6,269	10,465
Texas.....	14,559	19,166	33,725	20,777	16,006	36,783
Total, Southwestern.....	27,514	42,200	69,714	33,663	35,160	68,823
Illinois.....	46,151	47,881	94,032	57,178	66,236	123,414
Indiana.....	24,157	22,797	46,954	33,578	29,635	63,213
Iowa.....	9,332	12,033	21,365	10,239	13,477	23,716
Kansas.....	6,868	13,699	20,567	6,010	9,943	15,953
Michigan.....	50,192	35,644	85,836	62,818	64,755	127,573
Minnesota.....	39,394	16,989	56,383	45,643	14,816	60,459
Missouri.....	9,205	13,227	22,432	11,398	18,164	29,562
Nebraska.....	3,111	7,985	11,096	2,283	4,783	7,066
North Dakota.....	339	5,810	6,149	103	3,674	3,777
Ohio.....	57,463	64,533	121,996	90,247	79,777	170,024
South Dakota.....	697	3,352	4,049	505	2,049	2,554
Wisconsin.....	20,526	21,085	41,611	30,697	26,395	57,092
Total, North Central.....	267,435	265,035	532,470	350,699	333,704	684,403
Arizona.....	652	5,871	6,523	1,665	5,373	7,038
Colorado.....	5,985	5,672	11,657	4,399	3,865	8,264
Idaho.....	501	2,435	2,936	729	1,346	2,075
Montana.....	695	3,756	4,451	549	2,486	3,035
Nevada.....	550	1,990	2,540	603	885	1,488
New Mexico.....	834	2,274	3,108	630	1,765	2,395
Utah.....	1,154	3,837	4,991	1,101	2,257	3,358
Wyoming.....	1,875	1,214	3,089	1,364	804	2,168
Total, Rocky Mountain.....	12,246	27,049	39,295	11,040	18,781	29,821
California.....	59,621	43,733	103,354	49,572	36,253	85,825
Oregon.....	9,344	7,149	16,493	4,742	6,258	11,000
Washington.....	13,261	8,207	21,468	12,119	10,654	22,773
Total, Pacific coast.....	82,226	58,089	141,315	66,433	53,165	119,598
Total, United States.....	641,142	662,107	1,303,249	769,860	780,638	1,550,498

CONSUMPTION

In gathering data on the consumption of scrap in 1944, the practice of the 2 previous years was continued, in that figures on the use of scrap in the production of ferro-alloys and for various miscellaneous uses are included.¹⁶ Figures for some States are grouped to avoid disclosing the details of individual operations.

The large use of scrap as compared with that of pig iron again was noticeable in the New England, Southwestern, and Pacific Coast districts in 1944.¹⁷ These districts used 6 percent of the scrap consumed in the United States but only 2 percent of the pig iron. The ratio of scrap to pig iron in these three districts was 3.08:1, whereas for the United States at large it was 1.01:1.

Open-hearth steel furnaces are by far the largest consumers of ferrous scrap and pig iron. The portions of the total scrap and pig iron supply used in open-hearth furnaces have remained relatively constant as the following data will show: Open-hearth consumption accounted for 67 percent of the total scrap and in 1944, 65 percent in 1943, and 66 percent in 1942; 73 percent of the home scrap in 1944, 73 percent in 1943, and 71 percent in 1942; 57 percent of the purchased scrap in 1944, 55 percent in 1943, and 59 percent in 1942; and 79 percent of the pig iron in 1944, 78 percent in 1943, and 77 percent in 1942.

A slight downward trend in cupola-furnace consumption is to be noted: Home scrap, 10 percent of the total in 1944, 10 in 1943, and 12 in 1942; purchased scrap, 15 percent in 1944, 17 in 1943, and 19 in 1942; pig iron, 6 percent in 1944, 6 in 1943, and 8 in 1942. Taken together open-hearth and cupola furnaces in 1944 used 79 percent of the total scrap and 86 percent of the pig iron consumed.

Bessemer converters consumed 9 percent of the pig iron in 1944 (10 percent in 1943) but only about 0.6 percent of the scrap.

Electric furnaces consumed 10 percent of the total scrap in 1944 (11 percent in 1943) but only about 0.4 percent of the pig iron.

Ferrous scrap and pig iron consumed in the United States and percent of total derived from home scrap, purchased scrap, and pig iron, 1943-44, by districts

District	1943					1944				
	Total used (short tons)	Percent of total used			Pig iron	Total used (short tons)	Percent of total used			Pig iron
		Scrap ¹					Scrap			
		Home	Pur- chased	Total			Home	Pur- chased	Total	
New England.....	1,418,703	33.0	37.9	70.9	29.1	1,228,876	32.2	38.5	70.7	29.3
Middle Atlantic.....	43,358,843	28.4	19.0	47.4	52.6	42,712,527	29.0	18.5	47.5	52.5
Southeastern.....	14,645,127	26.3	17.4	43.7	56.3	15,021,937	25.7	18.4	44.1	55.9
Southwestern.....	624,460	22.7	72.8	95.5	4.5	708,436	27.3	50.3	77.6	22.4
North Central.....	57,567,666	30.0	22.0	52.0	48.0	57,469,322	30.1	21.3	51.4	48.6
Rocky Mountain.....	1,748,390	26.1	32.6	58.7	41.3	2,373,999	25.2	29.2	54.4	45.6
Pacific coast.....	2,602,926	20.9	60.5	81.4	18.6	2,786,725	25.0	52.0	77.0	23.0
	121,966,115	28.7	21.8	50.5	49.5	122,300,822	29.0	21.2	50.2	49.8

¹ Corrected figure.

¹⁶ Minerals Yearbook, 1942, p. 550; 1943, p. 533.

¹⁷ Minerals Yearbook, 1943, p. 533.

Proportion of home and purchased scrap and pig iron used in furnace charges in the United States, 1943-44, in percent

Type of furnace	1943				1944			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Open-hearth.....	29.1	16.9	46.0	54.0	29.2	16.6	45.8	54.2
Bessemer.....	4.0	1.7	5.7	94.3	4.6	1.9	6.5	93.5
Electric.....	46.2	48.4	94.6	5.4	47.2	49.2	96.4	3.6
Cupola.....	30.5	38.5	69.0	31.0	31.8	33.9	65.7	34.3
Air ¹	50.4	19.2	69.6	30.4	49.6	20.9	70.6	29.5
Crucible.....	51.0	27.9	78.9	21.1	41.3	17.2	58.5	41.5
Puddling.....	4.0	27.8	31.8	68.2	5.5	22.0	27.5	72.5
Blast.....	39.7	60.3	100.0		39.1	60.9	100.0	

¹ Includes data for 2 Brackelsberg furnaces.

Consumption of ferrous scrap and pig iron in the United States, 1943-44, by type of furnace, in short tons

Type of furnace or equipment	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
1943					
Open-hearth.....	148	25,442,119	14,771,599	40,213,718	47,107,608
Bessemer.....	37	268,691	112,241	380,932	6,257,927
Electric.....	382	3,377,561	3,536,860	6,914,421	393,819
Cupola.....	2,658	3,540,327	4,463,659	8,003,986	13,602,918
Air.....	126	890,257	339,171	1,229,428	537,902
Brackelsberg.....	3				
Crucible.....	18	1,102	603	1,705	457
Puddling.....	8	2,272	15,585	17,857	38,231
Blast.....	81	1,417,778	2,150,170	3,567,948	
Direct castings.....	39				2,376,297
Ferro-alloy.....	27	26,168	350,351	376,519	
Miscellaneous.....	153	70,813	873,629	944,442	
	* 3,680	35,037,088	26,613,868	61,650,956	60,315,159
1944					
Open-hearth.....	146	26,006,327	14,801,730	40,808,057	48,281,168
Bessemer.....	36	274,237	112,359	386,596	5,583,027
Electric.....	382	3,142,304	3,279,550	6,421,854	240,482
Cupola.....	2,604	3,654,301	3,888,691	7,542,992	13,941,159
Air.....	126	837,621	353,265	1,190,886	499,457
Brackelsberg.....	2				
Crucible.....	18	859	359	1,218	863
Puddling.....	7	2,141	8,563	10,704	28,166
Blast.....	78	1,422,118	2,216,342	3,638,460	
Direct castings.....	35				2,377,299
Ferro-alloy.....	27	19,675	311,357	331,032	
Miscellaneous.....	151	66,766	950,636	1,017,402	
	* 3,612	35,426,349	25,922,852	61,349,201	60,951,621

¹ Includes some pig iron used in making direct castings.

² Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

CONSUMPTION BY DISTRICTS AND STATES

As might be expected, the condition noted in the last six chapters on Iron and Steel Scrap in Minerals Yearbook prevailed during 1944 in that all 48 States, the District of Columbia, and Alaska were consumers of ferrous scrap and pig iron; and that the largest consuming districts were the North Central, Middle Atlantic, and Southeastern. Consumption in the Southwestern district has decreased markedly

from the 1942 and 1943 levels. The 8 States having the largest consumption of scrap, together with the percentage consumed, were: Pennsylvania 30, Ohio 20, Indiana 12, Illinois 8, Alabama 5, New York 5, Maryland 4, and Michigan 3. The above order is slightly at variance with that noted in 1943; Alabama and New York have changed positions, as have Maryland and Michigan.

Consumption of ferrous scrap and pig iron in the United States in 1940-44, by districts

District and year	Active plants reporting	Scrap						Pig iron	
		Home		Purchased		Total		Short tons	Change from previous year (percent)
		Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)		
New England:									
1940	270	283,607	+17.7	413,993	+7.3	697,600	+11.3	301,997	+26.0
1941	267	489,163	+72.5	566,952	+36.9	1,056,115	+51.4	476,768	+57.9
1942	271	494,569	+1.1	616,166	+8.7	1,110,735	+5.2	491,986	+3.2
1943	266	467,711	-5.4	538,469	-12.6	1,006,180	-9.4	412,523	-16.2
1944	255	396,205	-15.3	472,742	-12.2	868,947	-13.6	359,929	-12.8
Middle Atlantic:									
1940	831	8,197,874	+40.4	5,607,105	+20.3	13,804,979	+31.5	17,400,042	+42.0
1941	859	11,472,727	+39.9	7,796,243	+39.0	19,268,970	+39.6	20,787,804	+19.5
1942	914	11,190,820	-2.5	8,446,963	+8.3	19,637,783	+1.9	22,392,004	+7.7
1943	916	12,292,266	+9.8	8,251,262	-2.3	20,543,528	+4.6	22,815,315	+1.9
1944	890	12,395,873	+8	7,907,164	-4.2	20,303,037	-1.2	22,409,490	-1.8
Southeastern:									
1940	473	3,137,588	+21.0	2,485,652	+23.1	5,623,240	+21.9	6,905,435	+18.0
1941	490	3,761,458	+19.9	2,825,903	+13.7	6,587,361	+17.1	7,699,004	+11.5
1942	526	3,669,073	-2.5	2,981,358	+5.5	6,650,431	+1.0	8,356,308	+8.5
1943	512	3,857,196	+5.1	2,540,189	-14.8	6,397,385	-3.8	8,247,742	-1.3
1944	501	3,861,555	+1.1	2,763,586	+8.8	6,625,141	+3.6	8,396,796	+1.8
Southwestern:									
1940	132	39,674	-5	135,909	+7.9	175,583	+5.9	4,434	-3.1
1941	139	74,059	+86.7	215,699	+58.7	289,758	+65.0	5,707	+28.7
1942	138	101,683	+37.3	352,460	+63.4	454,143	+56.7	7,481	+31.1
1943	136	141,916	+39.6	454,731	+29.0	596,647	+31.4	27,813	+271.8
1944	134	193,181	+36.1	356,371	-21.6	549,552	-7.9	158,884	+471.3
North Central:									
1940	1,377	12,801,283	+23.5	9,622,839	+13.6	22,424,122	+19.1	20,926,271	+28.6
1941	1,424	17,227,439	+34.6	12,329,204	+28.1	29,556,643	+31.8	26,358,963	+26.0
1942	1,490	16,793,338	-2.5	12,814,917	+3.9	29,608,255	+2.6	26,855,971	+1.9
1943	1,442	17,276,757	+2.9	12,685,489	-1.0	29,962,246	+1.2	27,605,420	+2.8
1944	1,426	17,284,440	-----	12,281,465	-3.2	29,565,905	-1.3	27,903,417	+1.1
Rocky Mountain:									
1940	66	260,825	+16.4	341,269	+21.5	602,094	+19.2	458,209	+11.1
1941	75	421,191	+61.5	446,745	+30.9	867,936	+44.2	645,038	+40.8
1942	87	436,470	+3.6	533,604	+19.4	970,074	+11.8	666,938	+3.4
1943	91	456,135	+4.5	570,034	+6.8	1,026,169	+5.8	722,221	+8.3
1944	92	598,494	+31.2	691,503	+21.3	1,289,997	+25.7	1,083,002	+50.0
Pacific coast:									
1940	258	326,872	+2.9	875,181	+14.7	1,202,053	+11.2	189,440	+4.8
1941	277	458,643	+40.3	1,130,830	+29.2	1,589,473	+32.2	212,158	+12.0
1942	285	443,419	-3.3	1,390,311	+22.9	1,833,730	+15.4	272,195	+28.3
1943	317	545,107	+22.9	1,573,694	+13.2	2,118,801	+15.5	484,125	+77.9
1944	324	696,601	+27.8	1,450,021	-7.9	2,146,622	+1.3	640,103	+32.1
United States:									
1940	13,407	25,047,723	+27.7	19,481,948	+16.6	44,529,671	+22.6	46,185,828	+31.1
1941	13,531	33,904,680	+35.4	25,311,576	+29.9	59,216,256	+33.0	56,185,472	+21.7
1942	13,701	33,129,372	-2.3	27,135,779	+7.2	60,265,151	+1.8	59,042,883	+5.1
1943	13,680	35,037,088	+5.8	26,613,868	-1.9	61,650,956	+2.3	60,315,159	+2.2
1944	13,612	35,426,349	+1.1	25,922,852	-2.6	61,349,201	-5	60,951,621	+1.1

¹ Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

Consumption of ferrous scrap and pig iron in the United States, in 1944, by States and districts

State and district	Active plants reporting	Scrap						Pig iron	
		Home		Purchased		Total		Short tons	Per cent of total
		Short tons	Per cent of total	Short tons	Per cent of total	Short tons	Per cent of total		
Connecticut.....	67	124, 290	0.4	155, 740	0.6	280, 030	0.5	101, 816	0.2
Maine.....	21	8, 731	(1)	5, 033	(1)	13, 764	(1)	6, 543	(1)
Massachusetts.....	123	209, 529	.6	255, 215	1.0	464, 744	.8	192, 870	.3
New Hampshire.....	17	7, 006	(1)	14, 982	.1	21, 988	(1)	6, 785	(1)
Rhode Island.....	13	35, 931	.1	29, 761	.1	65, 692	.1	39, 858	.1
Vermont.....	14	10, 718	(1)	12, 011	(1)	22, 729	(1)	12, 057	(1)
Total New England.....	255	396, 205	1.1	472, 742	1.8	868, 947	1.4	359, 929	.6
Delaware.....	10	480, 248	1.4	502, 675	1.9	982, 923	1.6	355, 486	.6
New Jersey.....	110								
New York.....	242								
Pennsylvania.....	518	1, 667, 041	4.7	1, 290, 496	5.0	2, 957, 537	4.8	2, 958, 342	4.9
Total Middle Atlantic.....	880	12, 395, 873	35.0	7, 907, 164	30.5	20, 303, 037	33.1	22, 409, 490	36.8
Alabama.....	93	1, 419, 872	4.0	491, 989	1.9	1, 911, 861	3.1	3, 263, 647	5.4
District of Columbia.....	4	1, 748, 430	4.9	1, 258, 656	4.8	3, 005, 086	4.9	3, 185, 611	5.2
Kentucky.....	28								
Maryland.....	33								
Florida.....	21	55, 206	.2	124, 679	.5	179, 885	.3	89, 835	.1
Georgia.....	60	902	(1)	1, 680	(1)	2, 582	(1)	903	(1)
Mississippi.....	13								
North Carolina.....	58	12, 686	(1)	8, 550	(1)	21, 236	.1	18, 062	.1
South Carolina.....	21	3, 555	(1)	14, 136	.1	17, 691	(1)	4, 779	(1)
Tennessee.....	68	167, 021	.5	205, 628	.8	372, 649	.6	162, 913	.3
Virginia.....	69								
West Virginia.....	33	455, 883	1.3	658, 268	2.5	1, 114, 151	1.8	1, 671, 046	2.7
Total Southeastern.....	601	3, 861, 555	10.9	2, 763, 586	10.6	6, 625, 141	10.8	8, 396, 796	13.8
Arkansas.....	13	29, 605	.1	45, 009	.2	74, 614	.1	6, 826	(1)
Louisiana.....	26								
Oklahoma.....	23								
Texas.....	72	163, 576	.4	311, 362	1.2	474, 938	.8	152, 058	.2
Total Southwestern.....	134	193, 181	.5	356, 371	1.4	549, 552	.9	158, 884	.2
Illinois.....	249	3, 282, 095	9.3	2, 892, 538	11.2	6, 174, 633	10.1	5, 158, 045	8.5
Indiana.....	160	4, 057, 976	11.4	1, 889, 633	7.3	5, 947, 609	9.7	7, 453, 187	12.2
Iowa.....	59	163, 907	.5	236, 293	.9	400, 200	.7	103, 055	.2
Kansas.....	34	28, 797	.1	85, 751	.3	114, 548	.2	10, 381	(1)
Nebraska.....	15								
Michigan.....	216	2, 510, 071	7.0	1, 505, 606	5.8	4, 015, 677	6.5	2, 332, 201	3.8
Wisconsin.....	130								
Minnesota.....	76								
Missouri.....	75	240, 215	.7	277, 286	1.1	517, 501	.8	443, 943	.8
North Dakota.....	2	205, 873	.6	552, 589	2.1	758, 462	1.2	130, 537	.2
South Dakota.....	1	941	(1)	414	(1)	1, 355	(1)	412	(1)
Ohio.....	409	6, 794, 565	19.2	4, 841, 355	18.7	11, 635, 920	19.0	12, 271, 656	20.1
Total North Central.....	1, 426	17, 284, 440	48.8	12, 281, 465	47.4	29, 565, 905	48.2	27, 903, 417	45.8
Arizona.....	13	9, 808	.1	80, 473	.3	90, 281	.1	91	(1)
Nevada.....	4								
New Mexico.....	4								
Colorado.....	29	578, 272	1.6	582, 967	2.3	1, 161, 239	1.9	1, 082, 544	1.8
Utah.....	26								
Idaho.....	6	1, 154	(1)	5, 779	(1)	6, 933	(1)	123	(1)
Wyoming.....	1	(1)	(1)	(1)	(1)	(1)	(1)	2	(1)
Montana.....	9	9, 259	(1)	22, 278	.1	31, 537	.1	242	(1)
Total Rocky Mountain.....	92	598, 494	1.7	691, 503	2.7	1, 289, 997	2.1	1, 083, 002	1.8
Alaska.....	1	150, 678	.4	379, 679	1.5	530, 357	.9	39, 614	.1
Oregon.....	53								
Washington.....	76								
California.....	194	545, 923	1.6	1, 070, 342	4.1	1, 616, 265	2.6	600, 489	.9
Total Pacific coast.....	324	696, 601	2.0	1, 450, 021	5.6	2, 146, 622	3.5	640, 103	1.0
Total United States:									
1944.....	3, 612	35, 426, 349	100.0	25, 922, 852	100.0	61, 349, 201	100.0	60, 951, 621	100.0
1943.....	3, 680	35, 037, 088	100.0	26, 613, 868	100.0	61, 650, 956	100.0	60, 315, 159	100.0

¹ Less than 0.05 percent.

² Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each appears as 1 plant in the total.

CONSUMPTION BY TYPE OF FURNACE

Open-hearth furnaces.—Ferrous scrap and pig iron consumed in open-hearth furnaces in 1944 totaled 89,089,225 short tons, a 2-percent increase over 1943. The use of home scrap increased 2 percent, of purchased scrap 1 percent, of total scrap $1\frac{1}{2}$ percent, and of pig iron 2 percent.

Charges to open-hearth furnaces in 1944 consisted of 46 percent total scrap and 54 percent pig iron, the proportions being the same as in 1942 and 1943. Of the total scrap consumed, 36 percent was purchased compared with 37 percent in 1943, 41 percent in 1942, and 40 percent in 1941.

Pennsylvania led in the use of scrap in the open-hearth in 1944, followed in order by Ohio, Indiana, and Illinois, which ranking is unchanged from 1943.

Consumption of ferrous scrap and pig iron in open-hearth furnaces in the United States in 1944, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut.....	1	122, 679	225, 381	348, 060	151, 208
Massachusetts.....	2				
Rhode Island.....	1				
Total: 1944.....	4	122, 679	225, 381	348, 060	151, 208
1943.....	4	131, 744	240, 347	372, 091	181, 759
Middle Atlantic:					
Delaware.....	1	1, 481, 791	883, 227	2, 365, 018	2, 798, 314
New Jersey.....	3				
New York.....	8				
Pennsylvania.....	51	8, 185, 286	4, 019, 807	12, 205, 093	15, 494, 048
Total: 1944.....	63	9, 667, 077	4, 903, 034	14, 570, 111	18, 292, 362
1943.....	64	9, 558, 870	5, 160, 095	14, 718, 965	18, 345, 418
Southeastern and Southwestern:					
Alabama.....	4	1, 110, 591	413, 506	1, 524, 097	2, 959, 583
Georgia.....	1				
Tennessee.....	1				
Oklahoma.....	1	1, 965, 231	1, 373, 093	3, 368, 324	4, 103, 367
Texas.....	1				
District of Columbia.....	1				
Kentucky.....	2	4, 981, 576	2, 712, 251	7, 693, 827	8, 696, 927
Maryland.....	1				
West Virginia.....	2				
Total: 1944.....	14	3, 105, 822	1, 786, 599	4, 892, 421	7, 062, 950
1943.....	14	3, 029, 165	1, 667, 012	4, 696, 177	6, 776, 050
North Central:					
Illinois.....	11	2, 202, 364	1, 553, 580	3, 755, 944	3, 704, 471
Indiana.....	8	3, 655, 213	1, 539, 434	5, 194, 647	6, 845, 940
Michigan.....	4	1, 022, 966	241, 358	1, 264, 324	1, 501, 716
Iowa.....	1	134, 469	376, 937	511, 406	70, 095
Missouri.....	3				
Minnesota.....	1				
Wisconsin.....	2	189, 385	159, 801	349, 186	403, 912
Ohio.....	25	4, 981, 576	2, 712, 251	7, 693, 827	8, 696, 927
Total: 1944.....	55	12, 185, 973	6, 583, 361	18, 769, 334	21, 223, 061
1943.....	57	12, 102, 286	6, 505, 112	18, 607, 398	20, 738, 424
Rocky Mountain and Pacific coast:					
Colorado.....	1	924, 776	1, 303, 355	2, 228, 131	1, 551, 587
California.....	7				
Utah.....	1				
Washington.....	1	924, 776	1, 303, 355	2, 228, 131	1, 551, 587
Total: 1944.....	10	924, 776	1, 303, 355	2, 228, 131	1, 551, 587
1943.....	9	620, 054	1, 199, 033	1, 819, 087	1, 065, 957
Total United States: 1944.....	146	26, 006, 327	14, 801, 730	40, 808, 057	48, 281, 168
1943.....	148	25, 442, 119	14, 771, 599	40, 213, 718	47, 107, 608

Bessemer converters.—The total of 5,969,623 short tons of ferrous raw materials used in bessemer converters in 1944 represents a 10-percent decrease from the 1943 use of these materials. The proportion of scrap in the metal charges was 7 percent, of which 71 percent was home scrap.

Following the pattern of the three previous years, Pennsylvania was the principal consumer of scrap in converters in 1944.

Consumption of ferrous scrap and pig iron in bessemer converters in the United States in 1944, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England and Middle Atlantic:					
Connecticut.....	1	8,999	7,703	16,702	4,900
Delaware.....	2				
New York.....	2				
Pennsylvania.....	9	91,651	49,519	141,170	1,947,583
Total: 1944.....	14	100,650	57,222	157,872	1,952,482
1943.....	15	94,477	57,193	151,670	2,272,468
Southeastern and Southwestern:					
Alabama.....	1	27,570	23,682	51,252	594,974
Maryland.....	1				
Mississippi.....	1				
West Virginia.....	1				
Louisiana.....	1				
Texas.....	1				
Total: 1944.....	6	27,570	23,682	51,252	594,974
1943.....	6	33,350	17,533	50,883	624,310
North Central and Pacific coast:					
Illinois.....	3	10,136	15,776	25,912	346,101
Indiana.....	1				
Iowa.....	1				
Michigan.....	2	24,777	15,355	40,132	347,220
Minnesota.....	1				
Missouri.....	1				
California.....	1	212	244	456	110
Washington.....	1				
Ohio.....	5				
Total: 1944.....	16	146,017	31,455	177,472	2,035,671
1943.....	16	140,864	37,515	178,379	2,361,149
Total United States: 1944.....					
1943.....	36	274,237	112,359	386,596	5,583,027
	37	268,691	112,241	380,932	6,257,927

Electric steel furnaces.—Ferrous scrap and pig iron used in electric furnaces in 1944 amounted to 6,662,336 short tons, a decrease of nearly 9 percent from the record consumption of 7,308,240 tons in 1943. The recent high consumption of ferrous raw materials in electric-furnace practice is a direct reflection of the tremendous increase in the number of these furnaces, which amounts to "a 287.5 percent increase in electric furnace capacity."¹⁸

The decrease of 153,339 short tons of pig iron consumed in 1943 from the 1942 consumption is in large part due to a decrease of 138,469 tons in Ohio, which is a reflection of changes in melting practice.

¹⁸ War Plants Disposal, Iron and Steel Plants, Second Progress Report on the Preparation of Joint Hearings on the Disposal of Surplus Iron and Steel Plants and Facilities to be held by the War Contracts Subcommittee of the Committee on Military Affairs and the Industrial Reorganization Subcommittee of the Special Committee on Postwar Economic Policy and Planning, June 14, 1945, p. 16.

Consumption of ferrous scrap and pig iron in electric steel furnaces in the United States in 1944, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut.....	5	13,369	10,185	23,554	1,100
New Hampshire.....	1				
Rhode Island.....	1				
Massachusetts.....	12	32,521	17,755	50,276	999
Total: 1944.....	19	45,890	27,940	73,830	2,099
1943.....	19	67,797	34,743	102,540	2,396
Middle Atlantic:					
Delaware.....	1	112,245	78,446	190,691	3,779
New Jersey.....	12				
New York.....	22				
Pennsylvania.....	62	845,125	704,204	1,549,329	19,450
Total: 1944.....	97	1,082,151	910,029	1,992,180	29,794
1943.....	98	1,099,321	963,442	2,062,763	30,363
Southeastern:					
District of Columbia.....	1	41,144	65,501	106,645	642
Kentucky.....	1				
Maryland.....	2				
West Virginia.....	1	37,049	52,275	89,324	1,152
Alabama.....	7				
Florida.....	1				
Georgia.....	3	25,637	21,886	47,523	1,258
Mississippi.....	1				
North Carolina.....	1				
Tennessee.....	5	103,830	139,662	243,492	3,052
Virginia.....	4				
Total: 1944.....	28	103,830	139,662	243,492	3,052
1943.....	26	116,615	159,723	276,338	5,394
Southwestern:					
Arkansas.....	2	58,096	57,265	115,361	2,039
Oklahoma.....	2				
Louisiana.....	4				
Texas.....	12	58,096	57,265	115,361	2,039
Total: 1944.....	20	58,096	57,265	115,361	2,039
1943.....	19	51,810	58,606	110,416	1,215
North Central:					
Illinois.....	27	398,801	466,545	865,346	28,110
Indiana.....	13	38,343	35,905	74,248	2,226
Iowa.....	4	35,008	31,623	66,631	451
Kansas.....	1				
Nebraska.....	1				
Michigan.....	31	265,392	249,521	514,913	24,177
Minnesota.....	4	6,864	10,353	17,217	404
Missouri.....	10	18,658	18,751	37,409	2,256
Ohio.....	37	789,420	922,197	1,711,617	134,679
Wisconsin.....	14	100,753	110,047	210,800	7,510
Total: 1944.....	142	1,653,239	1,844,942	3,498,181	199,813
1943.....	145	1,851,578	1,978,390	3,829,968	350,156
Rocky Mountain:					
Arizona.....	2	8,248	15,113	23,361	310
Colorado.....	2				
Nevada.....	1				
Utah.....	1	8,248	15,113	23,361	310
Total: 1944.....	6	8,248	15,113	23,361	310
1943.....	6	9,820	17,537	27,357	298
Pacific coast:					
Alaska.....	1	21,107	62,434	83,541	228
Oregon.....	11				
California.....	36				
Washington.....	22	69,367	91,171	160,538	645
Total: 1944.....	70	190,850	284,599	475,449	3,375
1943.....	69	180,620	324,429	505,049	3,997
Total United States 1944.....	382	3,142,304	3,279,550	6,421,854	240,482
1943.....	382	3,377,561	3,536,860	6,914,421	393,819

Cupola furnaces.—In 1944 cupola furnaces used 11,487,151 short tons of scrap and pig iron, a decrease of 1 percent from 1943. The use of home scrap increased 1 percent, purchased scrap decreased 13 percent, total scrap decreased 6 percent, and pig iron increased 9 percent. The decrease in purchased scrap and the increase in pig iron were due to the marked shortage of good cast scrap and the availability of pig iron for cupola use.

Charges to cupola furnaces consisted of 32 percent home scrap, 34 percent purchased scrap, and 34 percent pig iron, compared to 31, 38, and 31 percent, respectively, in 1943.

The relative position of the principal scrap-consuming States changed slightly from 1943 in that Wisconsin exceeded New York in 1944. Michigan used the largest tonnage, followed in order by Ohio, Illinois, Pennsylvania, Wisconsin, and New York.

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1944, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut.....	52	59,483	41,081	100,564	60,153
Maine.....	21	8,731	5,033	13,764	6,543
Massachusetts.....	99	81,726	89,329	171,055	82,732
New Hampshire.....	14	2,187	14,291	16,478	4,898
Rhode Island.....	10	15,497	10,381	25,878	12,575
Vermont.....	14	10,718	12,011	22,729	12,057
Total: 1944.....	210	178,342	172,126	350,468	178,958
1943.....	219	207,553	207,596	415,149	200,260
Middle Atlantic:					
Delaware.....	5	3,261	4,006	7,267	3,344
New Jersey.....	73	111,044	133,123	244,167	122,532
New York.....	168	196,055	223,420	419,475	220,260
Pennsylvania.....	299	339,949	397,618	737,567	510,897
Total: 1944.....	545	650,309	758,167	1,408,476	857,033
1943.....	571	669,301	870,929	1,540,230	843,541
Southeastern:					
Alabama.....	68	224,559	107,194	331,753	450,777
District of Columbia.....	2				
Maryland.....	24	35,230	54,137	89,367	23,201
Florida.....	20	1,330	2,364	3,694	1,268
Georgia.....	54	19,195	30,876	50,071	27,886
Kentucky.....	23	20,669	17,159	37,828	61,401
Mississippi.....	11	540	1,172	1,712	903
North Carolina.....	57	12,631	8,550	21,181	17,963
South Carolina.....	20	3,555	2,710	6,265	4,779
Tennessee.....	58	91,209	73,551	164,760	116,263
Virginia.....	62	47,863	88,690	136,553	44,499
West Virginia.....	21	11,341	33,321	44,662	9,341
Total: 1944.....	420	468,122	419,724	887,846	758,281
1943.....	432	473,072	551,335	1,024,407	743,640
Southwestern:					
Arkansas.....	11	454	1,174	1,628	271
Louisiana.....	20	2,659	3,105	5,764	1,902
Oklahoma.....	19	4,693	11,841	16,434	3,635
Texas.....	53	24,871	76,321	101,192	20,141
Total: 1944.....	103	32,577	92,441	125,018	25,949
1943.....	106	32,812	109,868	142,680	11,700
North Central:					
Illinois.....	175	439,751	340,112	779,863	379,146
Indiana.....	115	200,977	169,361	370,338	209,167
Iowa.....	51	105,551	92,807	198,358	90,576
Kansas.....	33	19,248	71,465	90,713	6,829
Michigan.....	168	650,271	530,166	1,180,437	484,428
Minnesota.....	65	47,456	107,733	155,189	45,244
Missouri.....	55	61,994	133,334	195,328	61,325
Nebraska.....	13	4,211	6,370	10,581	3,199
North Dakota.....	2				
South Dakota.....	1	941	414	1,355	412

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1944, by districts and States, in short tons—Continued

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
North Central—Continued.					
Ohio.....	273	399,340	445,428	844,768	493,315
Wisconsin.....	101	246,748	180,655	427,403	207,435
Total: 1944.....	1,052	2,176,488	2,077,845	4,254,333	1,981,076
1943.....	1,055	1,987,481	2,289,847	4,277,328	1,679,934
Rocky Mountain:					
Arizona.....	6	6,535	19,935	26,470	1
Colorado.....	22	18,307	66,617	84,924	30,556
Idaho.....	5	736	2,504	3,240	123
Montana.....	6	7,741	5,090	12,831	242
Nevada.....	1	509	5,328	5,837	20
New Mexico.....	2				
Wyoming.....	1				
Utah.....	15	1	6	7	2
		21,793	45,224	67,017	20,194
Total: 1944.....	58	55,622	144,704	200,326	51,138
1943.....	60	63,467	160,659	224,126	44,058
Pacific coast:					
California.....	135	72,896	166,220	239,116	68,402
Oregon.....	38	8,435	22,581	31,016	9,979
Washington.....	43	11,510	34,883	46,393	10,343
Total: 1944.....	216	92,841	223,684	316,525	88,724
1943.....	215	106,641	273,425	380,066	79,785
Total United States: 1944.....	2,604	3,654,301	3,888,691	7,542,992	3,941,159
1943.....	2,658	3,540,327	4,463,659	8,003,986	3,602,918

Includes some pig iron used in making direct castings.

Air furnaces.—Scrap and pig iron consumed in air furnaces in 1944 amounted to 1,690,343 short tons, a 4-percent decrease from the 1,767,330 tons melted in this type of furnace in 1943. The use of home scrap decreased 6, purchased scrap 4, and pig iron 7 percent.

There was no change in the relative position of the principal consuming States. As in 1942 and 1943, Ohio led in the use of scrap in air furnaces, followed in order by Illinois, Pennsylvania, Indiana, Michigan, Wisconsin, and New York.

Consumption of ferrous scrap and pig iron in air furnaces¹ in the United States in 1944, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut.....	7	22, 233	5, 926	28, 159	12, 384
Massachusetts.....	3				
New Hampshire.....	1				
Rhode Island.....	1				
Total: 1944.....	12	43, 108	15, 496	58, 606	27, 359
1943.....	12	44, 195	14, 902	59, 097	27, 815
Middle Atlantic:					
Delaware.....	1	12, 969	2, 765	15, 734	8, 769
New Jersey.....	2				
New York.....	13				
Pennsylvania.....	24				
Total: 1944.....	40	181, 660	76, 231	257, 891	115, 572
1943.....	41	192, 481	68, 165	260, 646	128, 340
Southeastern and Southwestern:					
West Virginia.....	2	13, 494	10, 599	24, 093	7, 168
Texas.....	1				
Total: 1944.....	3	13, 494	10, 599	24, 093	7, 168
1943.....	3	13, 700	8, 642	22, 342	7, 242

See footnote at end of table.

Consumption of ferrous scrap and pig iron in air furnaces¹ in the United States in 1944, by districts and States, in short tons—Continued

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
North Central:					
Illinois.....	15	222,031	95,182	317,213	136,658
Indiana.....	9				
Michigan.....	7	88,524	27,206	115,730	51,811
Iowa.....	1	11,853	3,696	15,549	10,847
Minnesota.....	1				
Missouri.....	1	207,100	99,128	306,228	104,170
Ohio.....	22				
Wisconsin.....	11	66,089	24,981	91,070	42,305
Total: 1944.....	67	595,597	250,193	845,790	345,791
1943.....	69	633,413	246,567	879,980	370,146
Rocky Mountain and Pacific coast:					
Colorado.....	1	3,762	744	4,506	3,567
California.....	2				
Washington.....	1	4	3,762	4,506	3,567
Total: 1944.....	4				
1943.....	4	6,468	895	7,363	4,359
Total United States: 1944.....	126	837,621	353,265	1,190,886	499,457
1943.....	129	890,257	339,171	1,229,428	537,902

¹ Includes 2 Brackelsberg furnaces, 1 each in Indiana and Ohio.

Crucible and puddling furnaces.—Crucible and puddling furnaces consumed only minor amounts of ferrous raw materials. The consumption in these furnaces reached a high point of slightly over 30,000 short tons a year in 1941 and 1942, dropped to 19,562 tons in 1943, and experienced a further decrease to 11,922 tons in 1944.

Consumption of ferrous scrap and pig iron in crucible and puddling furnaces in the United States in 1944, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Massachusetts.....	2	467	213	680	103
New Hampshire.....	1				
Total: 1944.....	3	467	213	680	103
1943.....	4	402	273	675	61
Middle Atlantic and Southeastern:					
New Jersey.....	2	9	3,777	3,786	9,511
New York.....	2				
Kentucky.....	1	2,271	4,911	7,182	18,874
Pennsylvania.....	11				
Total: 1944.....	16	2,280	8,688	10,968	28,385
1943.....	15	2,852	15,898	18,750	38,440
North Central:					
Indiana.....	1	216	16	232	438
Ohio.....	1				
Wisconsin.....	1	3	216	232	438
Total: 1944.....	3				
1943.....	4	72	15	87	148
Southwestern and Pacific coast:					
Oklahoma.....	1	37	5	42	103
California.....	2				
Total: 1944.....	3	37	5	42	103
1943.....	3	48	2	50	39
Total United States: 1944.....	25	3,000	8,922	11,922	20,029
1943.....	26	3,374	16,188	19,562	38,688

Blast furnaces.—Materials other than scrap constitute by far the largest proportion of the blast-furnace charge and in 1944 were 94,129,085 net tons of iron and manganiferous ores, 18,946,302 tons of sinter, cinder, and mill scale, 3,518,855 tons of open-hearth and bessemer slag, 129,166 tons of raw flue dust, and 49,901 tons of miscellaneous materials.

Total consumption of scrap in 1944, as reported by 78 plants operating blast furnaces, was 3,638,460 net tons, a 2-percent increase over 1943. These figures do not include 11,710 tons of home and 29,100 tons of purchased scrap used in blast furnaces in the manufacture of ferro-alloys. The scrap charged to blast furnaces was divided into 39 percent home and 61 percent purchased as against 40 and 60 percent, respectively, in 1943 and 53 and 47 percent in 1942. The ratio of home to purchased scrap used in blast furnaces in 1944 is a continuation of the trend previously noted.¹⁰ The ratio of scrap used to pig iron produced is 5.96 percent as it was in 1943; purchased scrap accounted for 3.63 percent and home scrap 2.33 percent.

Consumption of ferrous scrap in blast furnaces in the United States in 1944, by districts and States, in short tons¹

District and State	Active plants reporting	Scrap		
		Home	Purchased	Total
New England and Middle Atlantic:				
Massachusetts.....	1	3,481	19,094	22,575
New York.....	6	30,030	72,069	102,099
Pennsylvania.....	21	650,033	785,338	1,435,371
Total: 1944.....	28	683,544	876,501	1,560,045
1943.....	30	660,023	794,217	1,454,240
Southeastern:				
Alabama.....	7	174,892	124,339	299,231
Kentucky.....	1	66,700	253,647	320,347
Maryland.....	1			
Tennessee.....	1			
West Virginia.....	2			
Total: 1944.....	12	241,592	377,986	619,578
1943.....	14	245,398	214,636	460,034
North Central:				
Illinois.....	6	97,949	240,612	338,561
Indiana.....	3	39,267	89,862	129,129
Michigan.....	2	49,140	103,956	153,096
Minnesota.....	2			
Ohio.....	20	294,355	521,857	816,212
Total: 1944.....	33	480,711	956,287	1,436,998
1943.....	34	505,864	1,140,466	1,646,330
Southwestern: Rocky Mountain and Pacific coast:				
Texas.....	1	16,271	5,568	21,839
Colorado.....	1			
Utah.....	2			
California.....	1			
Total: 1944.....	5	16,271	5,568	21,839
1943.....	3	6,493	851	7,344
Total United States: 1944.....	78	1,422,118	2,216,342	3,638,460
1943.....	81	1,417,778	2,150,170	3,567,948

¹ Does not include scrap used in blast furnaces for the production of ferro-alloys.

¹⁰ Minerals Yearbook, 1943 p. 545.

USE OF SCRAP IN FERRO-ALLOY PRODUCTION

The production of ferro-alloys in 1944 consumed 331,032 short tons of scrap, a 12-percent decrease from the 1943 figure. Purchased scrap accounted for 94 percent of the amount used, and home scrap 6 percent. Twenty-nine plants were engaged in this business, the same number as in 1943.

Of the scrap consumed in the manufacture of ferro-alloys, 12 percent was used in blast furnaces, 88 in electric furnaces, and 0.1 percent in the aluminothermic process.

Of a total of 27 plants producing ferro-alloys, 5 operated blast furnaces, 21 electric furnaces and 2 aluminothermic. The apparent discrepancy in the total count is due to the fact that at 1 plant both electric furnaces and the aluminothermic process were employed.

Consumption of ferrous scrap by ferro-alloy producers in the United States in 1944, by districts and States, in short tons

District and State	Active plants reporting	Scrap		
		Home	Purchased	Total
Middle Atlantic:				
New York.....	6	616	77,109	77,725
Pennsylvania.....	4	216	938	1,154
Total: 1944.....	10	832	78,047	78,879
1943.....	12	4,163	92,631	96,794
North Central:				
Iowa.....	1	18,814	140,258	159,072
Ohio.....	5			
Total: 1944.....	6	18,814	140,258	159,072
1943.....	7	21,988	157,036	179,024
Southeastern:				
Alabama.....	1	83,345	83,345	83,345
South Carolina.....	1			
Tennessee.....	2			
West Virginia.....	1			
Total: 1944.....	5	83,345	83,345	83,345
1943.....	4	89,705	89,705	89,705
Pacific coast:				
California.....	1	29	9,707	9,736
Oregon.....	2			
Washington.....	3			
Total: 1944.....	6	29	9,707	9,236
1943.....	4	17	10,979	10,996
Total United States: 1944.....	27	19,675	311,357	331,032
1943.....	27	26,168	350,351	376,519

MISCELLANEOUS USES

Slightly less than 2 percent of the 1944 consumption of scrap was for miscellaneous purposes, such as rerolling, in nonferrous metallurgy, and as a chemical agent. The amount so used—1,017,402 short tons—was an increase of 8 percent over the quantity used for these purposes in 1943. Of the amount used, 93 percent was purchased and 7 percent home scrap.

Consumption of ferrous scrap in miscellaneous uses in the United States in 1944, by districts and States, in short tons

District and State	Active plants reporting	Scrap		
		Home	Purchased	Total
New England:				
Massachusetts.....	4	967	11, 219	12, 186
Connecticut.....	1			
Total: 1944.....	5	967	11, 219	12, 186
1943.....	5	2, 642	10, 247	12, 889
Middle Atlantic:				
New Jersey.....	18	3, 572	93, 147	96, 719
New York.....	13	1, 152	68, 296	69, 448
Pennsylvania.....	24	27, 398	101, 843	129, 241
Total: 1944.....	55	32, 122	263, 286	295, 408
1943.....	58	24, 156	261, 939	286, 095
Southeastern:				
Alabama.....	4	53	21, 440	21, 493
Georgia.....	2	809	3, 775	4, 584
Tennessee.....	1			
Maryland.....	2	900	73, 627	74, 527
Virginia.....	3			
West Virginia.....	1			
Total: 1944.....	13	1, 762	98, 842	100, 604
1943.....	12	2, 948	99, 246	102, 194
Southwestern:				
Louisiana.....	1	216	26, 136	26, 352
Texas.....	3			
Total: 1944.....	4	216	26, 136	26, 352
1943.....	5	239	15, 728	15, 967
North Central:				
Illinois.....	9	4, 865	214, 417	219, 282
Indiana.....	8	19, 090	18, 139	37, 229
Michigan.....	2	2, 464	26, 343	28, 807
Nebraska.....	1			
Wisconsin.....	1	361	536	897
Minnesota.....	2			
Missouri.....	5	0	35, 158	35, 158
Ohio.....	10	750	102, 683	103, 433
Total: 1944.....	38	27, 530	397, 276	424, 806
1943.....	41	33, 402	331, 059	364, 461
Rocky Mountain:				
Arizona.....	5	422	51, 279	51, 701
Nevada.....	2			
New Mexico.....	2	2, 083	24, 891	26, 974
Colorado.....	2			
Idaho.....	1	1, 310	46, 110	47, 420
Montana.....	3			
Utah.....	6			
Total: 1944.....	21	3, 815	122, 280	126, 095
1943.....	20	5, 198	129, 986	135, 184
Pacific coast:				
California.....	8	320	28, 990	29, 310
Oregon.....	2	34	2, 607	2, 641
Washington.....	5			
Total: 1944.....	15	354	31, 597	31, 951
1943.....	12	2, 228	25, 424	27, 652
Total United States: 1944.....	151	66, 766	950, 636	1, 017, 402
1943.....	153	70, 813	873, 629	944, 442

FOREIGN TRADE²⁰

Imports.—Imports of iron and steel scrap in 1944 decreased 22 percent in volume (111,974 short tons as compared with 143,387 tons in 1943) and 18 percent in value (\$1,627,117 as compared to \$1,986,560 in 1943). Of the 1944 imports, 69,049 tons came from Canada, 14,862 from the Canal Zone, 11,533 from Cuba, 11,414 from Trinidad and Tobago, and the remainder in much smaller tonnages from other countries. In addition 19,402 tons of tin plate scrap were imported (16,192 tons from Canada) as compared with 21,927 tons in 1943 and 26,972 tons in 1942.

Exports.—Exports of ferrous scrap from the United States in 1944 were 95,419 short tons valued at \$1,894,980, an increase of 74 percent in tonnage and 77 percent in value over the figures for 1943. Exports were exceeded by imports by 16,555 short tons (not counting 19,402 tons of imported tin-plate scrap). In spite of the considerable increase in exports over 1943, the tonnage exported amounts to slightly less than 3 percent of the 5-year prewar average (for 1935-39) of 3,298,326 tons a year. The high requirement for scrap in this country was the major factor that resulted in this low volume of exports. The 1944 exports included 4,966 tons of tin-plate scrap, circles, strips, cobbles, and waste, and terne-plate clippings and scrap valued at \$431,725. The same materials in 1943 amounted to 1,949 tons valued at \$188,640. The accompanying table shows the principal countries to which scrap was exported during the period 1940-44.

Ferrous scrap exported from the United States, 1940-44, by countries, in short tons

Country	1940	1941	1942	1943	1944
Canada.....	411, 571	314, 555	121, 471	34, 085	71, 255
Germany.....					
Italy.....	356, 859				
Japan.....	1, 079, 141	324			
Mexico.....	42, 095	30, 119	15, 502	18, 157	17, 508
Netherlands.....	389				
Poland and Danzig.....					
United Kingdom.....	1, 100, 774	539, 650	142	115	
Other countries.....	168, 454	19, 601	4, 621	2, 537	6, 656
Total value.....	3, 159, 283 \$48, 314, 146	904, 249 \$15, 973, 863	141, 736 \$3, 321, 523	54, 894 \$1, 070, 809	95, 419 \$1, 894, 980

WORLD ASPECTS

Data on world production of iron and steel scrap in 1944 are not available, a continuation of the condition that prevailed in 1943.²¹

REVIEW BY COUNTRIES

Algeria.²²—The Algerian Group for Importation and Purchase of Scrap Iron has been reorganized. The objects of the group are all commercial, financial, and industrial operations relative to the purchase, sale, importation, exportation, requisition, collection, recuperation, storage, handling, transportation, and use of ferro-alloys, of new

²⁰ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

²¹ Minerals Yearbook, 1943, p. 549.

²² Daily Metal Reporter, Reorganize Algerian Scrap-Iron Import Group: Vol. 44, No. 205, October 21, 1944, p. 8.

castings and of all kinds of scrap iron, cast iron or steel needed for manufacturers of the national defense, of public services, of industry and of commerce.

*Argentina.*²³—Bids have been opened recently for the construction of a rolling mill with a maximum annual capacity of from 300,000 to 350,000 metric tons of blooms, which will be operated by a joint Government-private company. Other phases of the program involve the exploitation of iron-ore deposits now being operated on a small scale. It is obvious that the expanding of this industry means a larger consumption of scrap iron and steel in Argentina.

*Brazil.*²⁴—The Brazilian steel industry has set up a new milestone with the production of 45-pound steel rails for domestic use, and the production of rails in excess of 65 pounds will depend upon the completion of the new Volta Redonda steel plant. This plant expects to begin operation late in 1945. At the present time, the Brazilian steel industry supplies about 35 percent of domestic need, but it will have almost double that capacity when the Volta Redonda plant is completed.

Canada.—The 1944 production of steel ingots and castings mounted to 3,024,410 short tons, an increase of 1 percent over the previous year's output but 3 percent below the record of 3,121,000 tons set in 1942. In producing this steel, 1,511,518 tons of pig iron and 1,849,944 tons of scrap were used, the resulting ratio being 45 percent pig iron to 55 percent scrap. Compared with the percentage of scrap used in the 2 previous years (53 percent in 1942 and 54 percent in 1943), a slight tendency toward the use of more scrap and less pig iron is indicated. In 1944 scrap consumption consisted of 54 percent home and 46 percent purchased scrap, a substantial continuation of the previous year's practice.²⁵

Pig-iron production in 1944 increased 5 percent to 1,852,628 short tons from the 1943 production of 1,758,265 tons but was 6 percent lower than the record figure of 1,975,000 tons in 1942. In 1944, 101,454 tons of scrap iron and steel were used in the manufacture of pig iron. Of the 14 Canadian blast furnaces 8 were in blast.²⁶ In September, the War demand eased materially, and in the latter part of the month restrictions on certain civilian items were lifted. Further dropping off of war orders was noticed during October, and in the latter part of the month more orders for civilian use were placed. The rate of steel production during the year was generally above 80 percent and at times considerably higher. The rate of pig-iron production was estimated to be between 58 and 80 percent at different times during the year.

The scrap iron and steel situation seems to follow the usual pattern in that the severe winters effect materially collections of scrap which normally goes into the hands of the dealers. During the early months of the year, steel scrap was none too abundant, but during the late spring, summer, and fall months the supply situation improved so that the dealers and consumers were enabled to build up stocks that were

²³ Daily Metal Reporter, Argentina Plans to Develop Iron and Steel Industries: Vol. 44, No. 188, September 27, 1944, p. 11.

²⁴ American Metal Market, Brazilian Steel Industry Producing 45-pound Rails: Vol. 51, No. 26, February 5, 1944, p. 8.

²⁵ Department of Trade and Commerce, Dominion Bureau of Statistics, Monthly Report—Production of Iron and Steel in Canada, December 1944: Ottawa, Canada, pp. 1-3.

²⁶ Department of Trade and Commerce, Dominion Bureau of Statistics, Monthly Report—Production of Iron and Steel in Canada, December 1944: Ottawa, Canada, pp. 1-3.

deemed ample to satisfy all probable demands through the winter. On the other hand, cast scrap either was in balance with or below actual demands throughout the year.

No. 1 Heavy Melting was in good demand through the entire year, as were the other more acceptable grades of steel scrap. The less-desirable grades appear never to have been in short supply, and purchases were selective in the matter of borings, turnings, and alloy scrap. However, until the late summer or early fall practically all purchases appeared to have been made on ceiling prices. Early in the fall, however, prices as much as \$1.00 below ceiling prices were rumored, although no actual sales were reported. On December 1²⁷ prices were officially revised downward. In spite of the revision (from \$1.00 to \$2.50 a gross ton) particularly active buying did not develop.

The improved collection of scrap during the spring, summer, and fall months, noted above, resulted in great part from the scrap drives, particularly through the rural section. During the same months, considerable scrap was received from the mining districts, and relatively large shipments of this kind of scrap were made from the western part of the Dominion. There have been several press notices during the year to the effect that no battlefield scrap has reached the Canadian market. It is not definitely known whether this situation prevailed during the entire year, but no positive notices of receipts were noted.

Chile.—A plan to meet half of Chile's steel requirements by the construction of a new plant has been announced by Eugene S. Harri-man, consulting engineer of the Chilean Production Development Corp.²⁸ Actual operation of the plant, which is to have an annual capacity of 100,000 tons of finished steel, is to start in the summer of 1946. The expanding Chilean steel industry undoubtedly will offer a market for South American scrap. Chile exported iron and steel products in 1944.

*Luxembourg.*²⁹—Joseph Bech, Luxembourg's foreign minister, has stated that Luxembourg, freed from German occupation only 6 weeks, is now supplying 50,000 tons of steel and 75,000 tons of iron monthly to the United Nations. He also predicted that these amounts would be doubled within a few months. No information is available as to the source of raw material, but it is a fair assumption that battlefield and other wartime scrap, which should now be available in Europe in large quantities, forms an important part of the materials being melted.

²⁷ Daily Metal Reporter, Scrap Call Not Too Strong at Toronto: Vol. 44, No. 236, December 7, 1944, p. 11.

²⁸ American Metal Market, Chile to Invest \$20,000,000 for Steel Production Plant: Vol. 51, No. 58, March 23, 1944, p. 6.

²⁹ Daily Metal Reporter, Luxembourg Foundries are now working for Allies. Vol. 44, 214, November 3, 1944, p. 2.)

IRON ORE

By NORWOOD B. MELCHER AND JOHN HOZIK

SUMMARY OUTLINE

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SUMMARY

Production of iron ore in 1944 decreased 7 percent from 1943 as a result of a program to reduce considerably the stock of iron ore at plants using Lake Superior ores. Consumption in 1944 was virtually unchanged from 1943. The supply of ore was generally adequate in all consuming districts during the year. However, at year's end a critical supply situation resulting from a labor shortage existed in Alabama and threatened steel output unless an estimated 1,000 men were secured early in 1945. Ten percent of the iron ore used in Alabama in 1944 was from stock. In addition to losses of men to the armed forces, a crusher failure at the Spaulding mine caused a further reduction in ore output.

Manpower shortages in the Northeastern States prevented any important increase in production in that area despite increases in production capacity.

Western production was increased by the opening of four new mines during the year. The Lone Star Steel Co. shipped high-grade ore mined from the greensand beds of east Texas. This ore was shipped to blast furnaces in Illinois and steel furnaces in the Birmingham district. The Sheffield Steel Co. shipped ore from two mines in east Texas to blast furnaces in Illinois and steel furnaces in Houston. A large mine in southwestern Utah was opened in 1944 to ship low-sulfur ore to the Fontana, Calif., furnace.

Of interest to United States consumers of iron ore was the opening of the new Steep Rock mine on the Atikokan range of western Ontario. A considerable shipment of ore from this mine is expected in 1945; it probably will be shipped to United States furnaces.

Salient statistics of iron ore in the United States, 1943-44

	1943		1944	
	Gross tons	Value	Gross tons	Value
Crude iron ore:				
Production by districts:				
Lake Superior.....	95,596,789	(1)	88,294,284	(1)
Southeastern.....	14,051,854		11,469,700	
Northeastern.....	7,018,617		7,749,541	
Western.....	3,017,720		3,506,620	
	119,674,980	(1)	111,020,145	(1)
Production by mining methods:				
Open pit.....	86,849,778	(1)	82,393,899	(1)
Underground.....	32,825,202		28,626,246	
	119,674,980	(1)	111,020,145	(1)
Production by types of ore:				
Hematite.....	104,436,944	(1)	96,238,818	(1)
Brown ore.....	7,126,582		5,265,700	
Magnetite.....	8,110,837		9,514,555	
Carbonate.....	617		1,072	
	119,674,980	(1)	111,020,145	(1)
Shipments.....	118,622,412	(1)	112,073,286	(1)
Iron ore:²				
Production by districts:				
Lake Superior.....	85,789,017	(1)	79,111,320	(1)
Southeastern.....	8,478,736		7,121,676	
Northeastern.....	3,467,571		3,849,396	
Western.....	2,859,994		3,442,405	
Undistributed (byproduct ore).....	652,513		592,908	
	101,247,835	(1)	94,117,705	(1)
Production by types of product:				
Direct.....	79,833,785	(1)	73,260,136	(1)
Concentrates.....	17,622,674		16,648,364	
Sinter.....	3,138,863		3,616,297	
Byproduct material (pyrites cinder and sinter).....	652,513		592,908	
	101,247,835	(1)	94,117,705	(1)
Production by types of ore:				
Hematite.....	94,418,034	(1)	86,726,870	(1)
Brown ore.....	1,627,490		1,218,509	
Magnetite.....	4,549,181		5,578,807	
Carbonate.....	617		611	
Byproduct material (pyrites cinder and sinter).....	652,513		592,908	
	101,247,835	(1)	94,117,705	(1)
Shipments.....	99,462,850	\$269,016,546	95,135,675	\$256,885,512
Average value per ton at mine.....		2.70		2.70
Stocks at mines December 31.....	5,169,525	(1)	4,176,639	(1)
Imports.....	399,117	1,827,033	436,532	2,007,865
Exports.....	2,424,801	8,117,156	2,158,447	7,163,405
Consumption.....	100,456,989	(1)	99,942,454	(1)
Manganiferous ore:³				
Shipments.....	1,538,275	4,522,052	1,327,324	3,855,946

¹ Data not available.² Ore containing less than 5 percent manganese.³ Ore containing 5 to 35 percent manganese.

Price regulations.—The prices announced by the Lake Superior Iron Ore Association for Lake Superior iron ores April 17, 1940, were still in effect at the close of 1944, having been established by the Office or Price Administration, April 10, 1942, as ceiling prices. However, actual selling prices, which had averaged a few cents under the announced prices, were permitted to increase to the ceiling prices, in order to meet additional production costs.

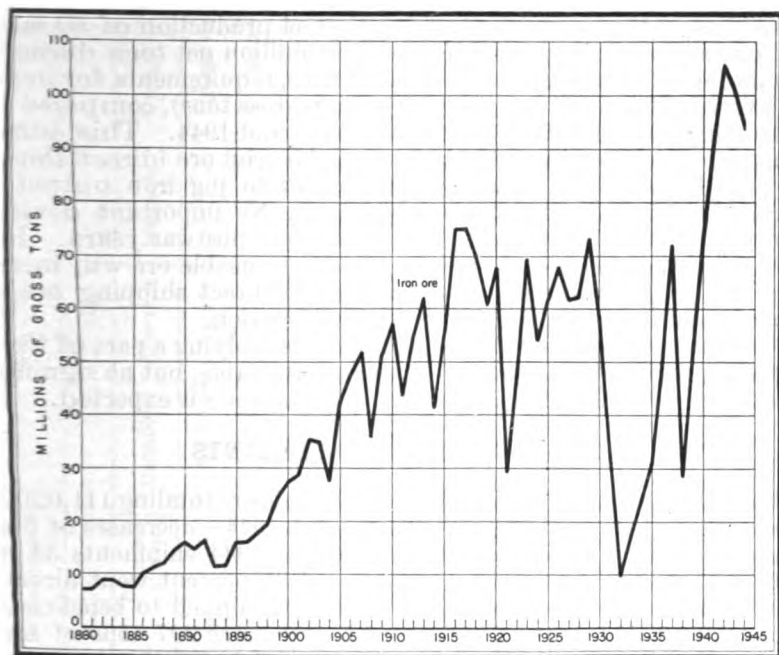


FIGURE 1.—Trends in production of iron ore in the United States, 1880-1944.

POSTWAR OUTLOOK

The long-term future of domestic iron ore depends largely on the feasibility of using the large reserves of low-grade Minnesota taconite. Technology has advanced to a point where 5 to 10 billion tons of high-grade concentrates could be made available from magnetic taconite with present methods. An additional 50 billion tons of non-magnetic taconite await further advancement in concentrating methods. The project initiated in 1943 at Battelle Memorial Institute, Columbus, Ohio, by 12 Lake Superior operators is continuing, and considerable advancement in this field is expected. It is apparent that Lake Superior operators are planning to use these vast reserves when it becomes necessary by reason of the approaching exhaustion of high-grade direct-shipping Mesabi ores.

Meanwhile, ample supplies of domestic ores are usable under present conditions to last a considerable time. Ernest F. Burchard of the Geological Survey and Albin C. Johnson of the Bureau of Mines recently have estimated the present reserves of commercial or usable grade iron ore at 5,478,000,000 gross tons, of which about one-third is classed as inferred ore.¹ Of this ore, 33 percent is situated in the Lake Superior district, 39 percent in the Southeastern district, 7 percent in the Northeastern district, and the Western and Central and Gulf States contain 7 and 4 percent, respectively.

The demand for iron ore in the immediate postwar years may be expected to be substantially below that during the war years. It

¹ Pehrson, Elmer W., *The Mineral Position of the United States and the Outlook of the Future: Min. and Met.*, vol. 28, No. 460, April 1945, p. 208.

seems reasonable to assume an annual steel production of 60 million net tons and a pig iron production of 40 million net tons during the 5 years following Japan's capitulation; thus, requirements for iron ore will average 70 million net tons (60 million gross tons), compared with approximately 100 million net tons in 1943 and 1944. This estimate is based on the fact that the ratio of usable iron ore (direct shipping ore plus beneficiation product) production to pig iron output has averaged 1.72:1 during the last 10 years. No important deviation from this ratio is likely during the immediate postwar years. However, the ratio of crude ore (ore as mined) to usable ore will increase with the gradual exhaustion of high-grade direct shipping ore and greater dependence on ore requiring beneficiation.

Foreign countries are expected to resume supplying a part of United States requirements as soon as shipping is available, but no significant increases above that furnished in the prewar years is expected.

PRODUCTION AND SHIPMENTS

United States iron-ore mines produced crude ore totaling 111,020,145 gross tons and shipped 112,073,286 tons in 1944—decreases of 6 and 7 percent, respectively, from 1943. Of the 1944 shipments 34 percent was sent to beneficiation plants, and 66 percent went direct to consumers, as in 1943. From the crude ore shipped to beneficiation plants, 16,648,364 tons of concentrate and 3,616,297 tons of sinter were produced. In addition, 592,908 tons of byproduct cinder and sinter were produced from the pyrites industry. In all, 94,117,705 gross tons of usable iron ore were produced at mines and mills in 1944. Output came from 224 mines, of which 26 mined over 1,000,000 tons of crude ore each. Minnesota, with 64,878,095 tons, supplied 69 percent of the usable ore; and Michigan, with 12,826,240 tons or 14 percent, was the second-largest producer. These two States and Wisconsin, with 1,406,985 tons or 1 percent, constitute the Lake Superior region, which supplied 84 percent of the domestic output. About three-fourths of the iron ore mined in 1944 came from open-pit mines

Crude iron ore mined in the United States, 1943-44, by States and varieties, in gross tons
 [Exclusive of ore containing 5 percent or more manganese]

State	1943					1944				
	Number of mines	Hematite	Brown ore	Magnetite	Total	Number of mines	Hematite	Brown ore	Magnetite	Total
Alabama.....	1 52	7,339,703	4,901,442	-----	12,241,145	1 28	6,517,770	3,530,348	-----	10,048,118
Arizona.....	2	-----	-----	-----	144	-----	-----	-----	-----	-----
Arkansas.....	1	-----	-----	144	794,440	1	-----	-----	76	76
California.....	4	683,751	-----	110,669	794,440	4	695,233	-----	150,027	845,260
Colorado.....	1	-----	200	-----	200	-----	-----	-----	-----	-----
Georgia.....	1 23	2,430	1,798,810	-----	1,801,240	1 8	-----	1,414,990	-----	1,414,990
Michigan.....	46	15,425,788	-----	-----	15,425,788	43	12,826,240	-----	-----	12,826,240
Minnesota.....	114	78,662,232	367,378	-----	79,029,630	103	74,061,059	-----	-----	74,061,059
Missouri.....	1 6	5,094	47,605	-----	52,699	1 4	10,232	9,050	-----	19,282
Nevada.....	6	942	-----	6,426	7,368	3	-----	-----	36,581	36,581
New Jersey.....	4	-----	-----	1,263,537	1,263,537	4	-----	-----	1,087,948	1,087,948
New Mexico.....	1 8	-----	-----	41,744	41,744	1	-----	-----	33,460	33,460
New York.....	6	-----	-----	5,754,463	5,754,463	7	1,239	-----	6,659,282	6,661,593
Pennsylvania.....	2	-----	1,678	-----	1,678	2	-----	1,038	-----	1,038
South Dakota.....	1	-----	-----	-----	1,200	1	-----	303,682	-----	306,185
Texas.....	1	1,200	-----	922,959	922,959	4	2,503	-----	1,542,281	1,542,284
Utah.....	3	-----	9,469	-----	9,469	5	3	-----	-----	6,592
Virginia.....	1	-----	-----	10,875	13,446	1	3,795	6,592	-----	6,592
Washington.....	3	2,571	-----	-----	2,571	2	1,406,985	-----	4,900	8,695
Wisconsin.....	2	1,498,749	-----	-----	1,498,749	2	713,759	-----	-----	1,406,985
Wyoming.....	1	814,203	-----	-----	814,203	1	-----	-----	-----	713,759
Total.....	1 287	104,436,944	7,126,582	8,110,837	119,674,980	1 224	96,238,818	5,265,700	9,514,555	111,020,145

! Excludes an undetermined number of small pits. Output of these pits included in tonnage given.

* Includes 617 tons of carbonate ore.

* Includes 1,098 tons produced in 1942.

* Includes 1,072 tons of carbonate ore.

Crude iron ore mined in the United States, 1943-44, by States and mining methods, in gross tons

State	1943			1944		
	Open pit	Underground	Total	Open pit	Underground	Total
Alabama.....	5,031,801	7,209,344	12,241,145	3,533,642	6,514,476	10,048,118
Arizona.....	261	261	261	76	76	76
Arkansas.....	144	144	144	76	76	76
California.....	794,440	794,440	794,440	845,260	845,260	845,260
Colorado.....	200	200	200	200	200	200
Georgia.....	1,801,240	1,801,240	1,801,240	1,414,990	1,414,990	1,414,990
Michigan.....	2,480,716	12,945,072	15,425,788	2,150,891	10,675,349	12,826,240
Minnesota.....	73,314,384	5,715,246	79,029,630	69,182,136	4,908,923	74,091,059
Missouri.....	48,964	3,735	52,699	16,813	2,469	19,282
Nevada.....	7,368	7,368	7,368	6,597	29,984	36,581
New Jersey.....	1,263,537	1,263,537	1,263,537	1,087,948	1,087,948	1,087,948
New Mexico.....	41,744	41,744	41,744	33,460	33,460	33,460
New York.....	2,383,535	3,371,545	5,755,080	3,376,973	3,284,620	6,661,593
Pennsylvania.....	1,678	1,678	1,678	1,038	1,038	1,038
South Dakota.....	1,200	1,200	1,200	306,185	306,185	306,185
Texas.....	922,959	922,959	922,959	1,542,284	1,542,284	1,542,284
Utah.....	9,469	9,469	9,469	6,592	6,592	6,592
Virginia.....	10,875	2,571	13,446	6,962	1,733	8,695
Washington.....	1,498,749	1,498,749	1,498,749	1,406,985	1,406,985	1,406,985
Wisconsin.....	814,203	814,203	814,203	713,759	713,759	713,759
Wyoming.....	86,849,778	32,825,202	119,674,980	82,393,899	28,626,246	111,020,145

Crude iron ore shipped from mines in the United States, 1943-44, by States and disposition, in gross tons

State	1943			1944		
	Direct to consumers	To beneficiation plants	Total	Direct to consumers	To beneficiation plants	Total
Alabama.....	5,928,562	6,314,190	12,242,752	5,007,952	5,049,364	10,057,316
Arizona.....	261	261	261	76	76	76
Arkansas.....	144	144	144	76	76	76
California.....	725,225	15,800	741,025	614,913	54,100	669,013
Colorado.....	200	200	200	200	200	200
Georgia.....	2,421	1,798,810	1,801,231	1,414,990	1,414,990	1,414,990
Michigan.....	14,510,357	14,510,357	14,510,357	13,693,377	13,693,377	13,693,377
Minnesota.....	53,687,887	25,363,846	79,051,733	50,775,368	23,475,225	74,250,593
Missouri.....	52,893	52,893	52,893	19,293	19,293	19,293
Nevada.....	7,368	7,368	7,368	32,281	32,281	32,281
New Jersey.....	166,685	1,106,098	1,272,783	116,163	969,591	1,085,754
New Mexico.....	41,744	41,744	41,744	33,460	33,460	33,460
New York.....	159,296	5,589,485	5,748,781	145,004	6,558,315	6,703,319
Pennsylvania.....	1,678	1,678	1,678	1,038	1,038	1,038
South Dakota.....	6,424	11,368	17,792	2,603	303,682	306,185
Texas.....	911,839	911,839	911,839	1,540,594	1,540,594	1,540,594
Virginia.....	13,455	13,455	13,455	8,695	8,695	8,695
Utah.....	911,839	911,839	911,839	1,540,594	1,540,594	1,540,594
Washington.....	1,392,173	1,392,173	1,392,173	1,536,737	1,536,737	1,536,737
Wisconsin.....	814,203	814,203	814,203	713,759	713,759	713,759
Wyoming.....	78,422,615	40,199,797	118,622,412	74,241,213	37,832,073	112,073,286

Shipments of usable ore from mines totaled 94,544,635 gross tons in 1944. Of this quantity, 74,241,213 tons (79 percent) were direct shipping ore for all uses. Total shipments also include 5,906 tons for cement manufacture, 9,779 tons for paint, and 234,496 tons for miscellaneous uses. Shipments of byproduct ore for iron and steel use totaled 591,040 tons in 1944 valued at \$2,906,656.

Iron ore mined in the United States, 1943-44, by mining districts and varieties, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

Variety of ore	Lake Superior district	Birmingham	Chat-tanooga	Adiron-dack and Cornwall	New Jersey and S. E. New York	Other	Total
1943							
Crude ore:							
Hematite.....	95,586,789	7,339,703	2,430			1,508,022	104,436,944
Brown ore.....		1,762,200	2,503,034			2,661,348	7,126,582
Magnetite.....				5,754,463	1,263,537	1,092,837	8,110,837
Carbonate.....						617	617
	95,586,789	9,101,903	2,505,464	5,754,463	1,263,537	5,462,824	119,674,980
Iron ore:							
Hematite.....	85,789,017	7,118,665	2,430			1,508,022	94,418,034
Brown ore.....		350,875	536,249			740,366	1,627,490
Magnetite.....				2,946,267	520,691	1,082,223	4,549,181
Carbonate.....						617	617
	85,789,017	7,469,440	538,679	2,946,267	520,691	3,331,228	100,595,322
1944							
Crude ore:							
Hematite.....	88,294,284	6,517,770				1,426,764	96,238,818
Brown ore.....		1,216,100	1,523,460			2,526,140	5,265,700
Magnetite.....				6,659,282	1,087,948	1,767,325	9,514,555
Carbonate.....						1,072	1,072
	88,294,284	7,733,870	1,523,460	6,659,282	1,087,948	5,721,301	111,020,145
Iron ore:							
Hematite.....	79,111,320	6,188,786				1,426,764	86,726,870
Brown ore.....		243,336	306,732			668,441	1,218,509
Magnetite.....				3,347,814	499,732	1,731,261	5,578,807
Carbonate.....						611	611
	79,111,320	6,432,122	306,732	3,347,814	499,732	3,827,077	93,524,797

Iron ore produced in the United States, 1943-44, by States and types of product, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	1943					1944				
	Direct shipping ore	Sinter ¹	Concen- trates	Total	Iron content, natural (percent)	Direct shipping ore	Sinter ¹	Concen- trates	Total	Iron content, natural (percent)
Mined ore:										
Alabama.....	5,922,606	1,077,721	1,057,058	8,057,385	38.16	4,997,889	1,173,231	658,317	6,829,437	38.18
Arizona.....	261	-----	-----	261	55.00	-----	-----	-----	-----	64.47
Arkansas.....	144	-----	-----	144	55.44	76	-----	-----	76	53.47
California.....	778,640	-----	5,186	783,826	56.08	791,160	-----	18,036	809,196	-----
Colorado.....	-----	-----	-----	39	49.20	-----	-----	-----	-----	-----
Georgia.....	2,430	-----	411,038	413,468	45.53	-----	-----	285,523	285,523	46.46
Michigan.....	15,425,788	-----	-----	15,425,788	51.94	12,836,240	-----	-----	12,836,240	51.84
Minnesota.....	54,031,870	211,173	14,841,864	69,084,907	52.07	50,602,129	160,983	14,114,983	64,878,095	51.95
Missouri.....	52,699	-----	-----	52,699	62.98	19,282	-----	-----	19,282	54.09
Nevada.....	7,368	-----	-----	7,368	62.98	36,581	-----	-----	36,581	64.09
New Jersey.....	166,887	-----	-----	166,887	52.09	116,013	-----	383,719	499,732	62.54
New Mexico.....	41,744	-----	-----	41,744	54.83	33,460	-----	-----	33,460	56.16
New York.....	151,004	1,849,969	945,911	2,946,884	56.90	162,042	2,282,083	905,539	3,349,664	64.19
Pennsylvania.....	1,678	-----	-----	1,678	40.00	1,038	-----	-----	1,038	56.33
South Dakota.....	1,200	-----	-----	1,200	50.00	2,503	-----	275,531	278,034	40.00
Texas.....	922,959	-----	-----	922,959	53.69	1,542,284	-----	-----	1,542,284	46.50
Utah.....	109	-----	7,774	7,883	37.25	-----	-----	6,716	6,716	37.25
Virginia.....	13,446	-----	-----	13,446	30.17	8,695	-----	-----	8,695	27.81
Washington.....	1,498,749	-----	-----	1,498,749	52.58	1,406,985	-----	-----	1,406,985	52.64
Wisconsin.....	814,203	-----	-----	814,203	52.19	713,759	-----	-----	713,759	53.84
Wyoming.....	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Byproduct ore: ²	79,833,785	3,138,863	17,622,674	100,595,322	51.00	73,260,136	3,616,297	16,648,364	93,524,797	51.20
Delaware.....	-----	-----	-----	-----	63.10	-----	-----	-----	-----	62.52
Michigan.....	-----	-----	-----	-----	66.00	-----	-----	-----	-----	66.00
Pennsylvania.....	-----	652,513	-----	652,513	63.45	-----	592,908	-----	592,908	67.60
Tennessee.....	-----	-----	-----	-----	67.30	-----	-----	-----	-----	59.00
Virginia.....	-----	-----	-----	-----	56.00	-----	-----	-----	-----	-----
Total.....	79,833,785	652,513	-----	652,513	64.32	-----	592,908	-----	592,908	63.77
	-----	3,791,376	17,622,674	101,247,835	51.08	73,260,136	4,209,205	16,648,364	94,117,705	51.29

¹ Exclusive of sinter produced at consuming plants.

² Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

are produced in the United States, 1943-44, by States and varieties, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	1943				1944			
	Hema- tite	Brown ore	Mag- netite	Total	Hema- tite	Brown ore	Mag- netite	Total
Alabama.....	7,118,565	938,820	-----	8,057,385	6,188,786	640,651	-----	6,829,437
Arizona.....	261	-----	-----	261	-----	-----	-----	-----
Arkansas.....	-----	-----	144	144	-----	-----	76	76
California.....	683,751	-----	100,075	783,826	695,233	-----	113,963	809,196
Colorado.....	-----	39	-----	39	-----	-----	-----	-----
Georgia.....	2,430	411,038	-----	413,468	-----	285,523	-----	285,523
Idaho.....	15,425,788	-----	-----	15,425,788	12,826,240	-----	-----	12,826,240
Illinois.....	68,864,480	220,427	-----	69,084,907	64,878,095	-----	-----	64,878,095
Indiana.....	5,094	47,605	-----	52,699	10,232	9,050	-----	19,282
Iowa.....	942	-----	6,426	7,368	-----	-----	36,581	36,581
Kansas.....	-----	-----	520,691	520,691	-----	-----	499,732	499,732
Michigan.....	-----	-----	41,744	41,744	-----	-----	33,460	33,460
Minnesota.....	-----	-----	2,946,267	2,946,884	1,239	-----	3,347,814	3,349,664
Missouri.....	-----	-----	-----	-----	-----	-----	-----	-----
Montana.....	-----	1,678	-----	1,678	-----	1,038	-----	1,038
Nebraska.....	1,200	-----	-----	1,200	2,803	275,531	-----	278,034
Nevada.....	-----	-----	922,959	922,959	3	-----	1,542,281	1,542,284
New Hampshire.....	-----	7,883	-----	7,883	-----	6,716	-----	6,716
New Jersey.....	-----	-----	10,875	13,446	3,795	-----	4,900	8,695
New Mexico.....	-----	-----	-----	1,498,749	1,406,985	-----	-----	1,406,985
New York.....	814,203	-----	-----	814,203	713,759	-----	-----	713,759
North Carolina.....	94,418,084	1,627,490	4,549,181	100,595,322	86,726,870	1,218,509	5,578,807	93,524,797
Ohio.....	-----	-----	-----	-----	-----	-----	-----	-----
Oklahoma.....	-----	-----	-----	-----	-----	-----	-----	-----
Oregon.....	-----	-----	-----	-----	-----	-----	-----	-----
Pennsylvania.....	-----	-----	-----	652,513	-----	-----	-----	592,908
Rhode Island.....	-----	-----	-----	-----	-----	-----	-----	-----
South Carolina.....	-----	-----	-----	-----	-----	-----	-----	-----
South Dakota.....	-----	-----	-----	-----	-----	-----	-----	-----
Texas.....	-----	-----	-----	-----	-----	-----	-----	-----
Utah.....	-----	-----	-----	-----	-----	-----	-----	-----
Vermont.....	-----	-----	-----	-----	-----	-----	-----	-----
Virginia.....	-----	-----	-----	-----	-----	-----	-----	-----
Washington.....	2,571	-----	-----	13,446	3,795	-----	-----	8,695
West Virginia.....	1,498,749	-----	-----	1,498,749	1,406,985	-----	-----	1,406,985
Wisconsin.....	814,203	-----	-----	814,203	713,759	-----	-----	713,759
Wyoming.....	-----	-----	-----	-----	-----	-----	-----	-----
By product ore: ¹	94,418,084	1,627,490	4,549,181	100,595,322	86,726,870	1,218,509	5,578,807	93,524,797
Delaware.....	-----	-----	-----	-----	-----	-----	-----	-----
Michigan.....	-----	-----	-----	652,513	-----	-----	-----	592,908
Pennsylvania.....	-----	-----	-----	-----	-----	-----	-----	-----
Tennessee.....	-----	-----	-----	-----	-----	-----	-----	-----
Virginia.....	-----	-----	-----	-----	-----	-----	-----	-----
Grand total.....	94,418,034	1,627,490	4,549,181	101,247,835	86,726,870	1,218,509	5,578,807	94,117,705

¹ Includes 617 tons of carbonate ore.

² Includes 611 tons of carbonate ore.

³ Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

Shipments of iron ore in the United States in 1944, by States and uses, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	Iron and steel			Cement	Paint	Miscellaneous	Total	
	Direct shipping ore	Sinter ¹	Concentrates				Gross tons	Value
Mined ore:								
Alabama.....	5,007,952	1,174,817	625,342	-----	-----	-----	6,808,111	\$17,684,154
Arkansas.....	76	-----	-----	-----	-----	-----	76	(²)
California.....	515,778	-----	-----	-----	-----	118,486	634,264	1,844,948
Georgia.....	-----	-----	285,523	-----	-----	-----	285,523	687,494
Michigan.....	13,693,377	-----	-----	-----	-----	-----	13,693,377	38,537,000
Minnesota.....	50,775,368	160,983	14,512,051	-----	-----	-----	65,448,402	160,853,166
Missouri.....	19,043	-----	-----	-----	250	-----	19,293	99,560
Nevada.....	1,606	-----	-----	-----	-----	30,675	32,281	230,664
New Jersey.....	116,163	-----	380,128	482	-----	2,026	498,799	3,455,213
New Mexico.....	33,460	-----	-----	-----	-----	-----	33,460	(²)
New York.....	143,765	2,281,959	499,571	-----	1,775	78,406	3,005,476	22,282,001
Pennsylvania.....	-----	-----	-----	-----	1,038	-----	1,038	(²)
South Dakota.....	-----	-----	275,531	-----	-----	-----	275,034	(²)
Texas.....	2,503	-----	-----	-----	-----	-----	2,503	(²)
Utah.....	1,538,962	-----	-----	1,629	-----	3	1,540,594	1,742,876
Virginia.....	-----	-----	-----	-----	6,716	-----	6,716	(²)
Washington.....	-----	-----	-----	3,795	-----	4,900	8,695	(²)
Wisconsin.....	1,536,737	-----	-----	-----	-----	-----	1,536,737	4,190,380
Wyoming.....	713,759	-----	-----	-----	-----	-----	713,759	(²)
Undistributed.....	-----	-----	-----	-----	-----	-----	-----	2,371,380
Byproduct ore:⁴	74,098,549	3,617,759	16,578,146	5,906	9,779	234,496	94,544,635	253,978,856
Delaware.....	-----	-----	-----	-----	-----	-----	-----	-----
Michigan.....	-----	591,040	-----	-----	-----	-----	591,040	2,906,656
Pennsylvania.....	-----	-----	-----	-----	-----	-----	-----	-----
Tennessee.....	-----	-----	-----	-----	-----	-----	-----	-----
Virginia.....	-----	-----	-----	-----	-----	-----	-----	-----
Grand total.....	74,098,549	4,208,799	16,578,146	5,906	9,779	234,496	95,135,675	256,885,512

¹ Exclusive of sinter produced at consuming plants.² Value included with "Undistributed."³ Includes values for States entered as "(2)."⁴ Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.**PRINCIPAL MINES**

In this discussion, the size of a mine is determined by the quantity of crude ore excavated. Consequently, mines providing low-grade ores, which require concentration, will be comparable in size to mines producing similar quantities of direct shipping ores. Twenty-six mines, each yielding more than 1,000,000 gross tons of crude ore, produced 55 percent of the United States output in 1944. Of these producers, 18 were in Minnesota, 3 in Alabama, 2 in New York, and 1 each in Utah, Wisconsin and Pennsylvania; 17 were open-pit operations, 5 underground, and 4 combination mines. Except for 4 mines that produced magnetite, all the million-ton mines produced hematite.

IRON ORE

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Iron-ore mines in the United States in 1944, by state of crude output

Name of mine	State	Nearest town	Range or district	Mining method	Production (Gross tons)	
					Crude ore	Unble ore
Hull-Rust-Burt-Sellers	Minnesota	Hibbing	Mesabi	Open pit	18,662,711	18,563,172
Northland-Moose	do	Virginia	do	do	4,391,157	4,391,157
Hill-Almex	do	Carmichael	do	do	3,702,333	2,387,278
Mountain Iron	do	Mountain Iron	do	do	2,400,868	2,400,868
Steele	do	Fresh	do	Combined	2,245,051	2,245,051
Keyhole	do	Nashauk	do	Open pit	2,167,588	1,080,185
Wahoning	do	Hibbing	do	do	2,027,498	2,027,498
Wenonah	Alabama	Bessemer	Birmingham	Underground	(1)	(1)
Guss Marble	Minnesota	Marble	Mesabi	Open pit	1,737,566	849,174
Hill-Trumbull	do	White	do	do	1,539,863	787,150
Leonard-Burt-Glen	do	Chisholm	do	do	1,521,268	1,490,663
Musoda	Alabama	Bessemer	Birmingham	Underground	1,464,648	(1)
Ishkooda	do	do	do	do	1,323,745	4,330,747
Embarras	Minnesota	White	Mesabi	Open pit	1,276,342	1,276,342
Fraser-D Autremont	do	Chisholm	do	do	1,256,744	1,256,744
Bingham-North Star	do	Taconite	do	do	1,244,739	978,704
Morrison-Walker	do	Coleraine	do	do	1,233,672	767,365
Missabe Mountain	do	Franklin	do	do	1,215,441	1,215,441
Morris	do	Hibbing	do	Combined	1,172,233	1,172,233
Mississippi	do	Nashauk	do	do	1,110,248	902,158
Iron Mountain	Utah	Cedar City	Iron Mountain	Open pit	1,103,170	1,103,170
Canisteo	Minnesota	Coleraine	Mesabi	do	1,096,199	667,146
Montreal	Wisconsin	Montreal	Gogebic	Underground	1,081,503	1,081,503
Cornwall	Pennsylvania	Cornwall	Cornwall	Combined	4,112,475	2,367,484
New Bed-Harmony and Old Bed	New York	Minerville	Adirondack	Underground	984,020	365,698
MacIntyre	do	Tahavus	do	Open pit	972,692	945,102
Benson	do	Clifton	do	do	954,923	605,826
Susquehanna	Minnesota	Hibbing	Mesabi	do	890,740	307,968
Danube	do	Coleraine	do	do	891,366	594,223
Chateaugay	New York	Lyon Mountain	Adirondack	Underground	885,000	196,450
Wegum	Minnesota	Hibbing	Mesabi	Open pit	788,471	788,471
Mitchell & Hodge	Georgia	Taylorville	Chattanooga	do	721,791	721,791
Hartley	Minnesota	Fraser	Mesabi	do	777,978	777,978
Webb	do	Hibbing	do	Combined	778,412	778,412
Wabigon	do	Buhl	do	Open pit	702,801	702,801
Bennett	do	Keewatin	do	do	761,948	761,948
Woodward No. 3	Alabama	Bessemer	Birmingham	Underground	759,855	759,855
Negaunee	Michigan	Negaunee	Marquette	do	744,279	744,279
Davis-Geneva-West Davis	do	Ironwood	Gogebic	Open pit		

1 Included with Ishkooda.
2 Includes Musoda and Wenonah.

Iron-ore mines in the United States in 1944, by size of crude output—Continued

Name of mine	State	Nearest town	Range or district	Mining method	Production (gross tons)	
					Crude ore	Usable ore
Scranton.....	Minnesota.....	Hibbing.....	Mesabi.....	Underground.....	726,697	726,697
Argonne.....	do.....	Nashauk.....	do.....	Open pit.....	725,750	338,506
Sunrise.....	Wyoming.....	Sunrise.....	Hartville.....	Underground.....	713,759	713,759
Output of 42 mines producing more than 700,000 tons crude ore each.....					73,780,905	63,287,038
Output of 11 mines producing 600,000 to 700,000 tons of crude ore each.....					7,025,240	5,509,912
Output of 13 mines producing 500,000 to 600,000 tons of crude ore each.....					7,399,043	5,855,857
Output of 12 mines producing 400,000 to 500,000 tons of crude ore each.....					5,160,815	4,505,489
Output of 19 mines producing 300,000 to 400,000 tons of crude ore each.....					6,447,954	5,282,425
Output of 16 mines producing 200,000 to 300,000 tons of crude ore each.....					4,020,343	3,471,132
Output of 27 mines producing 100,000 to 200,000 tons of crude ore each.....					4,217,565	3,410,211
Output of 25 mines producing 50,000 to 100,000 tons of crude ore each.....					1,803,704	1,482,218
Output of 58 mines producing under 50,000 tons of crude ore each.....					838,251	566,130
Output from reprocessed tailings (1 plant).....					326,325	154,385
Grand total of United States (224 * mines and 1 reprocessing plant).....					111,020,145	93,524,797

* Excludes an undetermined number of small pits. The output of these pits is included in the total given.

BENEFICIATION

Iron ore is concentrated by washing, jigging, and magnetic and high-density separation to remove objectionable impurities, thereby improving its grade. Fine ores are agglomerated or sintered into lumps, which are desirable in blast and steel furnaces because of their porous character and their improved grade and structure. Sintering likewise has a beneficial effect by reducing the sulfur and moisture content. At many mines the ore is crushed and screened to improve its physical characteristics, but ore known to be so improved is not included in the statistics on beneficiated ore.

In 1944, 20,264,661 gross tons of beneficiated ore were produced from 37,832,073 tons of crude ore. Beneficiation of iron ore was reported at 104 mines in 9 States in 1944 compared with 132 mines in as many States in 1943. Beneficiated ore shipped from domestic mine plants in 1944 decreased less than 1 percent from 1943 and totaled 20,303,422 tons; concentrates comprised 18 percent and sinter 4 percent of total usable ore shipments.

The production of beneficiated ore, concentrates, and sinter in 1944 decreased 2 percent from 1943, chiefly owing to efforts of companies in the Lake Superior district to ship as large a tonnage of direct shipping ore as possible, thereby meeting shipping quotas with a minimum of manpower input. The ratio of crude ore used to usable ore produced was 1.867:1 in 1944 compared with 1.936:1 in 1943.

Iron ore shipped from mines in the United States, 1925-29 (average), and 1940-44, in gross tons, and percentage of beneficiated ore compared to total shipped

[Exclusive of ore containing 5 percent or more manganese and ore sold for paint]

Year	Beneficiated	Total	Proportion of beneficiated to total (percent)	Year	Beneficiated	Total	Proportion of beneficiated to total (percent)
1925-29 (av.)	8,653,590	66,697,126	13.0	1942	23,104,945	105,313,653	21.9
1940	12,925,741	75,198,084	17.2	1943	20,117,685	98,817,470	20.4
1941	19,376,120	93,053,994	20.8	1944	20,303,422	94,544,635	21.5

¹ Includes ore for paint.

SINTER

Domestic sintering plants in 1944 used 12,247,501 gross tons of iron ore, 5,406,693 tons of flue dust, 338,270 tons of mill cinder and roll scale, 504,595 tons of pyrites cinder, and 4,096 tons of manganese bearing ore to produce 16,189,097¹ tons of sinter—a yield of 88 percent.

Sinter production in 1944 came from plants at mines, blast-furnace plants, custom mills, and a number of rotary cement kilns converted to iron-ore roasting. Of the sinter produced in the United States in 1944, 22 percent was made at mine plants in 4 States, and 78 percent was produced at blast-furnace plants and custom mills in 14 States.

Production and consumption of sinter in the United States in 1944, by States, in gross tons

State	Sinter produced	Sinter consumed	
		In blast furnaces	In steel furnaces
Alabama.....	1, 638, 286	1, 777, 075	89, 647
California.....	934, 102	888, 764	29, 722
Colorado.....			
Utah.....	154, 631		
Delaware.....	636, 082	641, 679	1, 507
Illinois.....	1, 075, 729	949, 604	128, 740
Indiana.....	426, 154	1, 054, 184	67, 796
Maryland.....			
Kentucky.....			
Tennessee.....			
West Virginia.....			
Michigan.....	474, 164	276, 219	119, 408
Minnesota.....	2, 935, 618	706, 996	108, 236
New York.....	3, 696, 668	3, 682, 953	543, 611
Ohio.....	4, 217, 663	3, 789, 635	327, 988
Pennsylvania.....			
-	16, 189, 097	13, 767, 109	1, 416, 655

AVERAGE VALUE

The average value per gross ton of iron ore at mines was \$2.70 in 1944 and 1943.

The accompanying table gives the average value at the mines of the different classes of iron ore in 1944 for each of the producing

Average value per gross ton of iron ore at mines in the United States, 1943-44

[Exclusive of ore containing 5 percent or more manganese]

State	1943						1944							
	Direct			Concentrates			Sinter	Direct			Concentrates			Sinter
	Hematite	Brown ore	Magnetite	Hematite	Brown ore	Magnetite		Hematite	Brown ore	Magnetite	Hematite	Brown ore	Magnetite	
Mined ore:														
Alabama.....	\$2. 43			(1)	\$2. 74		(1)	\$2. 32	(1)		(1)	\$2. 98		(1)
Georgia.....	(1)				2. 29							2. 41		
Michigan.....	2. 77							2. 81						
Minnesota.....	2. 44			\$2. 52	(1)		\$2. 84	2. 43			\$2. 54			\$2. 80
Missouri.....	3. 52	(1)						5. 06	(1)					
New Jersey.....			(1)			\$6. 86				(1)				\$6. 97
New Mexico.....			\$2. 49							(1)				
New York.....			(1)				5. 19	(1)		(1)				5. 78
Pennsylvania.....							5. 37							7. 96
Utah.....			(1)					(1)		\$1. 13				
Wisconsin.....	2. 75							2. 73						
Other ¹	2. 78	\$4. 07	3. 17		9. 02			1. 88	\$4. 00	6. 64		3. 36	8. 96	
Average, all States.....	2. 51	3. 02	3. 84	2. 55	2. 58	5. 77	6. 20	2. 49	4. 52	2. 18	2. 55	2. 93	6. 30	6. 28
Byproduct ore: ²														
Delaware.....														
Michigan.....							5. 02							4. 92
Pennsylvania.....														
Tennessee.....														
Virginia.....														

¹ Included with average for all States.

² Included under other States in 1943.

³ Includes Arizona, Colorado, and Utah in 1943 and Nevada in 1944. Also includes Arkansas, California, South Dakota, Texas, Virginia, Washington, and Wyoming in 1943 and 1944.

⁴ Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

States or groups of States, except when there are fewer than three shippers of a certain class of ore in a State and permission was not given to publish the value. These data are taken directly from statements of producers and probably represent the commercial selling prices only approximately, as not all reports are comparable. Some evidently include mining costs only; others contain, in addition, the cost of selling and insuring the ore; others include an allowance for a sinking fund; and still others comprise only costs charged against blast furnaces. None of the reports, however, is supposed to include freight charges.

CONSUMPTION

A total of 99,615,943 gross tons of metallurgical iron ore was reported consumed in 1944. Of this, 83 percent was consumed in iron blast furnaces, 12 percent in sintering plants, 4 percent in steel furnaces, and 1 percent in ferro-alloy furnaces. The 244,275 tons of "paint" and "all other" ore shipped from mines and mills in 1944 were assumed to have gone directly into consumption.

Consumption of iron ore in the United States in 1944, by States and uses, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	Metallurgical uses				Miscellaneous uses			Total
	Iron blast furnaces	Steel furnaces	Sintering plants	Ferro-alloy furnaces	Cement	Paint ¹	All other ¹	
Alabama.....	6,668,803	20,875	1,393,311	393	18,549	-----	-----	8,101,931
California.....	1,742,529	113,854	1,041,996	-----	16,298	-----	118,486	3,033,362
Colorado.....					196	-----	3	
Utah.....	8,265,495	362,945	351,392	-----	-----	-----	-----	8,979,832
Illinois.....	10,385,353	768,320	499,449	-----	4,123	-----	-----	11,657,245
Indiana.....	3,911,052	396,544	22,519	-----	3,079	-----	-----	
Kentucky.....			-----	-----	1,096	-----	-----	4,339,290
Maryland.....	2,478,876	100,536	147,090	-----	5,000	-----	-----	
Massachusetts.....					253	-----	-----	2,726,755
Tennessee.....	864,270	64,791	160,983	-----	7,220	250	-----	1,090,044
Michigan.....	-----	-----	-----	-----	-----	-----	30,675	7,470
Minnesota.....	-----	-----	-----	-----	-----	-----	2,026	30,675
Missouri.....	-----	-----	-----	-----	-----	-----	78,406	2,026
Nevada.....	-----	-----	-----	-----	-----	-----	-----	8,797,945
New Jersey.....	5,408,312	327,162	2,866,599	114,824	1,403	1,239	-----	20,543,157
New York.....	16,749,137	747,467	2,752,950	293,080	523	-----	-----	28,259,640
Ohio.....	24,005,585	1,227,212	3,011,212	3,335	11,760	536	-----	1,038
Pennsylvania.....	2,333,054	14,638	-----	-----	961	1,038	-----	2,360,917
South Dakota.....					-----	6,716	-----	
West Virginia.....	-----	-----	-----	-----	5,548	-----	-----	9,221
Virginia.....	-----	-----	-----	-----	4,321	-----	4,900	1,906
Texas.....	-----	-----	-----	-----	1,906	-----	-----	-----
Washington.....	-----	-----	-----	-----	-----	-----	-----	-----
Other States ¹	82,812,466	4,144,344	12,247,501	411,632	82,236	9,779	234,496	99,942,454

¹ Shipments from domestic mines.

² Exact consumption in Minnesota not known; estimated equal to sinter production.

³ Florida, Idaho, Kansas, Louisiana, Maine, Nebraska, and Montana.

STOCKS OF IRON ORE

Stocks of iron ore at mines on December 31, 1944, decreased 20 percent from 1943. Of the quantity in stock piles, 43 percent was at mines in Michigan, 31 percent in Minnesota, and 3 percent in Wisconsin—a total of 77 percent in the Lake Superior district.

Stocks of crude ore at mines totaled 2,869,226 gross tons on December 31, 1944, compared with 3,934,316 tons in 1943.

Stocks of iron ore at consuming plants totaled 32,914,774 gross tons on December 31, 1944, compared with 38,337,616 tons at the end of 1943. The decrease was a result of the cut-back in Lake shipments to reduce stocks at consuming plants.

Stocks of iron ore at mines, December 31, 1943-44, by States, in gross tons

State	1943	1944	State	1943	1944
Alabama.....	24, 833	44, 353	New York.....	310, 122	658, 245
California.....	57, 248	232, 179	Pennsylvania.....	7, 415	2, 799
Georgia.....	22	-----	Texas.....	900	-----
Michigan.....	2, 665, 567	1, 798, 028	Utah.....	11, 720	13, 476
Minnesota.....	1, 856, 270	1, 263, 251	Virginia.....	393	144
Missouri.....	106	31	Wisconsin.....	233, 426	117, 302
Nevada.....	-----	4, 400			
New Jersey.....	1, 503	2, 431		5, 169, 525	4, 136, 639

FOREIGN TRADE ¹

Increases in iron-ore imports from Mexico and North Africa resulted in a 16-percent increase in total imports during 1944.

Iron ore imported for consumption in the United States, 1942-44, by countries, in gross tons

Country	1942		1943		1944	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Algeria.....	-----	-----	89, 766	\$443, 744	134, 104	\$555, 703
Brazil.....	47, 600	\$188, 908	-----	-----	7	37
Canada ¹	256, 265	1 1, 145, 431	279, 222	1 1, 229, 520	255, 431	1 1, 191, 936
Chile.....	383, 330	689, 998	-----	-----	-----	-----
Colombia.....	-----	-----	-----	-----	10	33
Cuba.....	41, 165	83, 504	-----	-----	96	695
Mexico.....	2, 418	6, 974	16, 740	59, 680	62, 630	183, 335
Morocco, French.....	-----	-----	13, 074	77, 354	7, 449	37, 085
Oceania, French.....	-----	-----	2	10	-----	-----
Philippine Islands.....	9	75	-----	-----	-----	-----
Tunisia.....	-----	-----	-----	-----	3, 539	22, 597
United Kingdom ²	538	27, 679	313	16, 725	266	16, 444
	731, 325	2, 142, 569	399, 117	1, 827, 033	463, 532	2, 007, 865

¹ Includes pyrites cinder.

² United Kingdom of Great Britain and Northern Ireland.

Exports of iron ore from the United States totaled 2,158,447 gross tons, valued at \$7,163,504 (\$3.32 a ton) in 1944, compared with 2,424,801 tons valued at \$8,117,156 (\$3.35 a ton) in 1943. Of the total quantity of iron ore exported in 1944, Canada received 2,158,425 tons and Mexico 22 tons.

REVIEW OF LAKE SUPERIOR DISTRICT

Production and shipments.—Production of iron ore from mines in the Lake Superior district in 1944 was 6 percent lower than in 1943 and supplied 84 percent of the domestic output compared with 85

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

percent in 1943. The Mesabi was again the largest of the six producing ranges, supplying 70 percent of the district total and 56 percent of the United States total. The Lake Superior iron-ore data do not include production and shipments of 1,172,636 tons of ore containing 5 percent and more manganese.

The Lake Superior Iron Ore Association reported 80,674,010 tons of iron and manganiferous ore shipped to Great Lake ports from United States mines in 1944, a decrease of 4 percent from 1943. All-rail shipments totaled 1,182,995 gross tons in 1944 compared with 2,015,341 tons in 1943.

The first iron ore of the 1944 season was loaded at Escanaba on April 5, and the first at upper Lakes (Two Harbors) was loaded April 9. In 1943, the corresponding dates were April 4 and April 24. The Sault locks were opened by icebreakers on March 31, the average date being April 17. Favorable shipping weather enabled the industry to move large tonnages of ore earlier than in 1943. In April 1944, loadings totaled 5.3 million tons compared with 2 million tons in 1943. Shipments in May and June also exceeded those of the previous year. Thereafter, at the discretion of industry it was decided to decrease stocks of iron ore at consuming plants so that approximately 15 million tons would be on hand April 1, 1945. The effectiveness of the program is shown by the fact that an actual tonnage of 14,996,295 tons were on hand at the designated date. Lake shipments declined steadily after June and resulted in the over-all decrease for the year. The last vessel was loaded at Ashland on November 28 compared with December 6, 1943.

Iron ore produced in the Lake Superior district, 1854-1944, by ranges, in gross tons

[Exclusive after 1905 of ore containing 5 percent or more manganese]

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1854-1942.....	219,372,935	196,081,245	231,601,023	72,455,525	1,248,701,856	29,642,750	1,997,855,334
1943.....	5,680,727	5,366,585	5,877,215	1,782,237	63,334,939	1,747,304	85,789,017
1944.....	4,720,253	4,288,830	5,224,142	1,466,816	61,994,023	1,417,256	79,111,320
Total.....	229,773,915	205,736,670	242,702,380	75,704,578	1,376,030,818	32,807,310	2,162,755,671

The large Lake shipments during 1944 were not made without serious loss of life and property. Two collisions in a Lake Erie fog on April 27 caused the loss of two of the four vessels involved. The *James H. Reed*, an ore carrier with 7,500 tons aboard, went down with the loss of 12 lives. The *Frank E. Vigor*, a self-unloader with 6,000 tons of sulfur, went down without loss of life. Through great engineering skill, the *George M. Humphrey*, sunk by collision in fog in June 1943, was raised during 1944 from its position in 80 feet of water in the Straits of Mackinac. A valuable vessel and half of its cargo of ore were saved.

All ore vessels built by the Maritime Commission and 36 old trade-in boats were in service during 1944. A record movement of grain resulted in a new tonnage record for shipments of all commodities on the Great Lakes. The emergency ore dock built at Escanaba in 1942 was dismantled to provide lumber for more urgent requirements.

Mining developments.—The use of heavy trucks and belt conveyors to replace rail haulage at open-pit mines continued to expand in 1944, and new equipment for this purpose was acquired and placed in service during the year. Expansion and construction of ore concentrating plant facilities continued with new installations of crushing, screening, washing, and concentration equipment. The most spectacular open-pit development was at Embarrass Lake, on the eastern Mesabi range, where construction of a long drainage diversion ditch and dam, pumping of the lake, and stripping a large volume of overburden, were preliminaries to the successful opening of a large-tonnage mine. Underground development during 1944 included shaft deepening at mines on the Vermilion range in Minnesota and in the Wisconsin-Michigan ranges. At the Zenith mine on the Vermilion, the deep 66-inch borehole was enlarged into a rectangular shaft and equipped with a new head frame. A similar hole at the Cary mine on the Gogebic range in Wisconsin was completed, and its conversion to a rectangular shaft was in progress. Construction of the new head frame and mine buildings was underway. At the Pioneer mine on the Vermilion range, a new inclined offset replacing the shifting upper section of the vertical A shaft was completed and put in service.

The Geological Survey, in cooperation with the Michigan Geological Survey Division continued geological studies in the Iron River-Crystal Falls area of Michigan preparatory to further exploration. In a move to stimulate new exploration, the State of Michigan leased 12,000 acres of State-owned land in Dickinson County on 50-year contract to a large operating company.

Average costs, per gross ton, of mining iron ore at underground mines and at siliceous open pits in Michigan in 1944¹

Item	Underground				Siliceous open pits
	Gogebic	Marquette	Menominee	Average	
Cost of mining:					
Labor.....	\$1. 2675	\$1. 5738	\$1. 2463	\$1. 3742	\$0. 3171
Supplies.....	. 5954	. 6994	. 6059	. 6376	. 2383
Deferred costs.....	. 1674	. 0573	. 1739	. 1287	. 0477
Taxes.....	. 2438	. 2278	. 1254	. 1980	. 0682
General overhead.....	. 2938	. 1951	. 1436	. 1984	. 1259
Transportation.....	1. 8873	1. 5891	1. 7263	1. 7374	1. 5670
Marketing.....	. 0002	. 0986	. 0827	. 0816	. 0761
Total ore cost.....	4. 4884	4. 4411	4. 1041	4. 3559	2. 4403
Lake Erie value per ton.....	4. 8043	4. 7405	4. 3625	4. 6236	2. 4882
Gross ore profit ²	. 3159	. 2994	. 2584	. 2677	. 0479
Other costs:					
Royalty.....	. 3354	. 2264	. 2074	. 2514	. 0847
Interest on borrowed money.....	. 0002	. 0331	. 0031	. 0134	. 0051
Federal income and excess profits.....	. 1551	. 0535	. 1000	. 0998	. 0349

¹ Eddy G. E., General Statistics Covering Costs and Production of Michigan Iron Mines: Michigan Dept. of Conservation, Geol. Survey Div., 1945, 9 pp.

² This figure does not represent true profit, as much ore is sold below the Lake Erie price.

Analyses.—The following table was compiled by the Lake Superior Iron Ore Association.

Average analyses of total tonnages (bill-of-lading weights) of all grades of iron-ore from all ranges of Lake Superior district, 1940-44

Year	Gross tons	Iron (natural)	Phosphorus	Silica	Manganese	Moisture
		Percent	Percent	Percent	Percent	Percent
1940.....	63,308,413	52.09	0.085	8.00	0.77	10.93
1941.....	79,941,240	51.83	.085	8.18	.78	11.01
1942.....	92,069,902	51.65	.089	8.21	.79	10.98
1943.....	85,116,347	51.58	.091	8.32	.82	11.06
1944.....	81,039,404	51.72	.088	8.42	.74	11.02

Stocks at Lake Erie Ports.—On December 1, 1944, just before navigation stopped, the Lake Superior Iron Ore Association reported 5,472,556 tons of iron ore at Lake Erie ports compared with 6,393,581 tons in 1943. At the opening of the 1945 season (May 1, 1945) 1,959,675 tons of ore were in stock at these ports compared with 2,906,827 tons on May 1, 1944. Withdrawals from stocks during this 5-month period in 1944-45 were virtually unchanged from a year ago.

Prices of Lake Superior ore.—The prices established April 17, 1940, for the four standard grades of Lake Superior ore remained unchanged. Since that date the prices of the various grades quoted at Lake Erie ports for a long-ton unit were as follows: Old-Range Bessemer, 9.223 cents; Mesabi Bessemer, 8.932 cents; Old-Range Nonbessemer, 8.932 cents; and Mesabi Nonbessemer, 8.641 cents; respectively, \$4.75, \$4.60, and \$4.45 a gross ton. The base of the four standard grades since 1925 has been an iron content of 51.50 percent natural. For the Bessemer grades, the allowable phosphorus content is 0.045 percent (dry), and for the non-Bessemer grades the phosphorus content ranges from 0.045 to 0.18 percent. Ores containing more than 0.18 percent phosphorus are classed as high-phosphorus ores, whereas those containing 18 percent or more silica are classed as siliceous ores.

Reserves.—The following tables showing reserves of iron ore in Michigan and Minnesota were compiled by the Michigan Department of Conservation and the Minnesota Department of Taxation respectively. The Minnesota tonnage data are used for the purpose of tax assessment. An additional 13,197,467 tons on lands belonging to the State (not taxable) were available on May 1, 1944.

Iron-ore reserves in Michigan, January 1, 1940-45, in gross tons

Range	1941	1942	1943	1944	1945
Gogebic.....	31,603,731	30,073,528	32,001,951	32,791,848	32,686,550
Marquette.....	48,370,114	48,306,120	50,991,701	49,652,024	51,357,761
Menominee.....	55,851,786	56,130,084	55,563,724	53,902,631	50,376,403
	135,825,631	134,509,732	139,457,376	136,346,503	134,420,714

Unmined iron-ore reserves in Minnesota, May 1, 1940-44, in gross tons

	1940	1941	1942	1943	1944
Mesabi.....	1, 122, 593, 116	1, 097, 000, 026	1, 069, 752, 650	1, 043, 804, 381	1, 020, 138, 504
Vermilion.....	13, 208, 699	14, 018, 934	14, 903, 353	13, 449, 980	12, 636, 820
Cuyuna.....	65, 026, 280	65, 012, 265	64, 411, 762	63, 559, 458	62, 059, 815
Total Minnesota (Lake Superior district).....	1, 200, 828, 095	1, 176, 031, 225	1, 149, 067, 765	1, 120, 813, 819	1, 094, 835, 139
Filmore County.....			250, 000	259, 859	231, 393
	1, 200, 828, 095	1, 176, 031, 225	1, 149, 317, 765	1, 121, 073, 678	1, 095, 066, 532

MINING BY STATES

Alabama.—With the Republic Steel Corp. the only important buyer of brown ore, the total number of mines operating in Alabama declined from 52 in 1943 to 28 in 1944. The Red Mountain group of mines—the Ishkooda, Muscoda, and Wenonah—operated by the Tennessee Coal, Iron & Railroad Co., were the largest producers in the State during 1944. Their underground mines produced hematite, some of which was sintered before consumption, the rest being shipped direct to furnaces. Sinter was also produced at the Republic Steel Corp. Spaulding mine. Hematite from this mine was concentrated and mixed with pyrites cinder from Virginia and other materials before being sintered. Sinter produced from materials other than iron ore has been excluded from Alabama mine statistics but has been credited to sinter production at consuming plants. The Spaulding mine was forced to close down in September for several months because of a break-down of the primary crusher.

Total production of crude brown ore in Alabama in 1944 decreased 8 percent from 1943; virtually all of this ore was washed before shipment for consumption. The ratio of concentration was 5.36:1 in 1944 compared with 5.22:1 in 1943.

The Russellville 5, 11, and 12 and La Grange mines of the Sloss Sheffield Steel & Iron Co., the Giles mine of the Central Iron Ore Co., and the Docray mine of the Shook & Fletcher Supply Co. were the large brown-ore producers in the State.

Usable hematite produced in 1944 averaged 34.57 percent Fe, 0.15 percent Mn, 0.31 percent P, 16.23 percent SiO₂, and 14.68 percent CaO. Washed brown ore in 1944 contained 44.72 percent Fe, 0.55 percent Mn, 0.44 percent P, and 10.70 percent SiO₂.

Arkansas.—A small quantity of magnetite from the Magnet Cove mine in Hot Spring County was shipped for consumption in Alabama blast furnaces in 1944.

California.—Most of the production of iron ore (695,233 tons) in 1944, as in 1943, was hematite from the Vulcan mine near Kelso, San Bernadino County, which shipped to the Fontana furnace. A total of 95,929 tons of magnetite was produced near Redding, Shasta County, and was used as ballast on shipping vessels. Magnetite sand, shipped from a deposit near Watsonville, was also used as ballast. Ballast ore is usually graded according to specific gravity.

Georgia.—All of Georgia's output in 1944 was brown ore and came from eight mines and an undetermined number of small pits in Bartow, Cherokee, and Polk Counties. The largest output was from the Mitchell and Hodge operations in Bartow County.

Michigan and Minnesota.—See Review of Lake Superior District.

Missouri.—Production of iron ore from Missouri dropped from 52,699 tons in 1943 to 19,293 tons in 1944. However, the Iron Mountain mine was reopened in December by the M. A. Hanna Co., and production from this mine is expected to total 250,000 tons in 1945. Concentration by jigging and tabling will produce a product low in phosphorus containing 55 percent iron. Shipments are to blast furnaces at Granite City, Ill.

Nevada.—Most of the ore from Nevada was shipped from Pershing County by Heizer & Segerstrom for ship ballast. Some ore was shipped to the West coast for use in steel furnaces.

New Jersey.—Labor shortages continued to be a major problem in New Jersey during 1944. The Washington mine of the Alan Wood Steel Co. was forced to close in December because of insufficient miners. The employees released were offered the opportunity of employment at the company nearby Scrub Oaks mine.

A total of 1,087,948 tons of crude magnetite was produced from mines (all underground) in New Jersey in 1944. Direct lump ore amounting to 116,163 was shipped during the year. The remainder was concentrated magnetically, and 383,719 tons of concentrates were produced; none was sintered at mine plants.

New Mexico.—The St. Louis Smelting & Refining Co. El Paso iron claim at Hanover, Grant County, supplied the State total in 1944.

New York.—Magnetite was produced from six mines in the Adirondack district during 1944. Except for lump ore, which is used as a charge and finishing ore in open-hearth furnaces, all of the ore was shipped as concentrate or sinter.

The Old Bed-Harmony mine at Mineville was the largest producer. A new concentrator and sintering plant at the Fisher Hill mine was put into operation in 1944, using both Fisher Hill and Mineville ores.

Manpower shortages hindered production during the year as at other northeastern mines. It is established that 1,100 additional employees would be necessary to operate New York mines at capacity. Output in 1944 was at about one-half rated capacity.

The use of diamond-drill blast holes has recently proved satisfactory at Mineville and is finding additional application.

The Clinton Metallic Paint Co. produced hematite in Oneida County for use in paint during the year.

Pennsylvania.—Virtually all the ore from Pennsylvania was magnetite from the underground—open-pit operations of the Cornwall mine in Lebanon County. Ore from Cornwall is shipped to Lebanon, where it is concentrated magnetically and treated further by flotation to remove chalcopyrite, pyrite, and other minerals. Some magnetite concentrates are sintered, and some are shipped to consuming plants for sintering.

Carbonate ore from the Hazard and Little Gap mine in Carbon County was mined by the Prince Manufacturing Co. for use in paint.

South Dakota.—Paint ore was mined from the Iron Lode claims in Pennington County.

*Iron ore mined in the United States in 1944, by States and counties, in gross tons***[Exclusive of ore containing 5 percent or more manganese]**

State and county	Active mines	Crude ore	Usable ore	State and county	Active mines	Crude ore	Usable ore
Alabama:				Nevada:			
Bibb.....	1	390,000	76,747	Ormsby.....	1	357	357
Blount.....	1	93,000	18,614	Pershing.....	2	36,224	36,224
Butler.....	1	43,000	8,578		3	36,581	36,581
Calhoun.....	1	320	79				
Cherokee.....	13	60,250	12,283	New Jersey:			
Chilton.....	1	3,100	628	Morris.....	3	930,933	444,292
Colbert.....	1	595,056	71,999	Warren.....	1	157,015	55,440
Etowah.....	1	200	35		4	1,087,948	499,732
Franklin.....	15	1,565,572	295,080	New Mexico: Grant	1	33,460	33,460
Jefferson.....	8	6,647,770	6,214,818				
Montgomery.....	1	1,800	377	New York:			
Pike.....	1	350	72	Clinton.....	1	6,660,521	3,349,053
Talladega.....	12	47,700	8,812	Essex.....	3		
Tuscaloosa.....	1	600,000	121,315	Oneida.....	1		
	128	10,048,118	6,829,437	St. Lawrence.....	2		
Arkansas: Hot Spring	1	76	76	Pennsylvania:			
California:				Lebanon.....	1	1,072	611
San Bernardino.....	1	695,233	695,233	Carbon.....	1		
Santa Cruz.....	1	54,100	18,036		9	6,661,593	3,349,664
Shasta.....	2	95,927	95,927	South Dakota: Pennington	1	1,038	1,038
	4	845,260	809,196				
Georgia:				Texas:			
Bartow.....	1	877,300	171,922	Cherokee.....	1	306,185	278,034
Cherokee.....	1	41,300	8,417	Linden.....	1		
Polk.....	6	496,390	105,184	Llano.....	1		
	8	1,414,990	285,523	Morris.....	1		
Michigan:					4	306,185	278,034
Dickinson.....	3	736,397	736,397	Utah:			
Gogebic.....	8	3,817,157	3,817,157	Cache.....	1	1,542,284	1,542,284
Iron.....	16	3,552,433	3,552,433	Iron.....	4		
Marquette.....	16	4,720,253	4,720,253		5	1,542,284	1,542,284
	43	12,826,240	12,826,240	Virginia: Pulaski	1	6,592	6,716
Minnesota:							
Crow Wing.....	9	1,677,686	1,417,256	Washington:			
Itasca.....	30	21,282,191	13,318,873	Ferry.....	1	4,900	4,900
St. Louis.....	64	51,101,182	50,141,966	Stevens.....	1	3,795	3,795
	103	74,061,059	64,878,095		2	8,695	8,695
Missouri:				Wisconsin: Iron	2	1,406,985	1,406,985
Crawford.....	1	10,232	10,232	Wyoming: Platte	1	713,759	713,759
Franklin.....	1				224	111,020,145	93,524,797
Iron and St. Francois.....	1						
Various counties	1	9,050	9,050				
	14	19,282	19,282				

¹ In addition there is an undetermined number of small pits. The output of these pits is included in the tonnage given.² Includes output from 1 plant reprocessing tailings.

Texas.—Brown ore was mined from the Lone Star mine in Morris County by the Lone Star Steel Co., and from the North Basin mine in Linden County and the Mount Haven mine in Cherokee County by the Sheffield Steel Co. A very satisfactory open-hearth charge ore was produced by the Lone Star Steel Co., by calcining concentrated brown ore in a rotary kiln. Its blast furnace at Daingerfield had not yet operated in 1944.

Hematite was mined and shipped by Tillie B. Moss from the Moss mine in Llano County.

Utah.—Semi-altered magnetite was shipped from the Iron Mountain, Great Western, Duncan, and Walker Iron Mining (formerly the Excelsior) mines in Iron County. The last mine, operated by Senter F. Walker, was opened in 1944 to supply low-sulfur ore to the Fontana, Calif., blast furnace.

Virginia.—Brown ore produced from the American Pigment Corp. mine at Hiwassee, Pulaski County, constituted the only output from Virginia in 1944. All of the ore was washed before being used in the manufacture of paint.

Washington.—The Napoleon mine in Stevens County shipped hematite for cement manufacture during 1944. Iron ore for ballast was mined at the Neutral mine in Ferry County.

Wisconsin.—See Review of Lake Superior District.

Wyoming.—Hematite for Pueblo furnaces was mined at the Sunrise mine by the Colorado Fuel & Iron Corp. during 1944.

EMPLOYMENT AT IRON MINES

Complete data on employment at iron mines in 1944 are not yet available. Preliminary figures indicate an 18-percent decline in the number of workers from 1943. The average number employed is estimated at 27,200 men, working a total of 63,000,000 man-hours to produce 93,524,797 gross tons of ore—an average of about 1.5 tons per man-hour, an increase of 15 percent over 1943. The increase in efficiency in 1944 over 1943 was largely due to an increase in output at open-pit mines where production is at a much higher rate per man-hour than underground operations.

Increases in production at western open-pit mines also aided the output per man-hour in 1944. These mines which are shallow pits require very little handling of ore and consequently are very efficient in labor requirements.

Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man in 1943, by districts and States

[Exclusive of ore containing 5 percent or more manganese]

District and State	Employment				Production					
	Average number of men employed	Time employed			Crude ore (gross tons)		Usable ore		Average per man (gross tons)	
		Aver- age number of days	Total man- shifts	Man-hours	Gross tons	Iron contained (gross tons)	Crude ore		Usable ore	
							Per shift	Per hour	Per shift	Per hour
Lake Superior: Michigan..... Minnesota..... Wisconsin.....	8,318	291	2,420,971	8.0	19,367,826	15,425,788				
	12,567	281	3,534,068	8.0	28,265,034	79,029,630				
	839	276	231,574	8.0	1,862,589	1,498,749				
	21,724	285	6,186,613	8.0	49,485,449	95,954,167				
Southeastern States: Alabama..... Georgia..... Virginia.....	7,308	278	2,022,047	8.1	16,479,125	14,051,854				
		231								
Northeastern States: New Jersey..... New York..... Pennsylvania.....	7,308	277	2,022,047	8.1	16,479,125	14,051,854				
Iron contained										
Gross tons										
Percent natural										
Per shift										
Per hour										
Iron contained										
Per shift										
Per hour										

IRON ORE

5

[illegible]

WORLD PRODUCTION

The following table lists world iron-ore production by countries insofar as data are available:

World production of iron ore, 1930-44, by countries, in metric tons ¹

[Compiled by B. B. Waldbauer]

Country ¹	1939	1940	1941	1942	1943	1944
North America:						
Canada.....	117,583	376,120	468,138	494,691	581,769	496,878
Cuba.....	166,739	160,339	192,851	132,847	47,113	28,370
Mexico.....	143,873	110,783	110,134	130,822	168,148	186,961
Newfoundland.....	1,679,625	1,532,990	981,735	1,209,228	551,515	471,824
United States.....	52,562,024	74,878,718	93,892,753	107,219,890	102,872,863	95,628,294
South America:						
Brazil (exports).....	396,938	255,548	420,756	308,921	322,802	205,798
Chile ²	1,626,490	1,749,840	1,702,692	408,587	299,411	674,529
Europe:						
Belgium.....	177,370	(³)	(³)	(³)	(³)	(³)
Bulgaria.....	20,115	30,000	(³)	(³)	(³)	(³)
Czechoslovakia ⁴	766,000	862,000	978,000	1,040,000	(³)	(³)
France.....	(³)	12,731,070	10,570,450	12,757,620	16,879,160	9,265,290
Germany ⁵	(³)	(³)	(³)	(³)	(³)	(³)
Austria.....	(³)	(³)	(³)	(³)	(³)	(³)
Greece.....	307,284	(³)	(³)	(³)	(³)	(³)
Hungary.....	370,000	(³)	(³)	(³)	(³)	(³)
Italy.....	947,994	1,179,422	1,340,410	(³)	(³)	(³)
Luxemburg.....	(³)	(³)	(³)	(³)	(³)	(³)
Norway.....	1,340,408	⁷ 607,000	566,513	⁷ 300,000	218,024	(³)
Poland.....	(³)	(³)	(³)	(³)	(³)	(³)
Portugal.....	418	301	287	18	(³)	(³)
Rumania.....	131,992	(³)	(³)	180,570	(³)	(³)
Spain.....	2,556,089	2,012,238	1,718,979	1,606,161	1,587,817	1,658,805
Sweden.....	13,787,202	11,289,807	(³)	(³)	(³)	(³)
Switzerland.....	⁸ 171,279	200,000	313,803	316,767	285,798	(³)
U. S. S. R. ⁹	(³)	27,500,000	22,742,110	(³)	(³)	(³)
United Kingdom: Great Britain ¹⁰	14,721,446	18,170,539	19,120,129	19,581,271	18,658,952	(³)
Yugoslavia.....	666,816	¹¹ 553,926	¹¹ 523,000	(³)	(³)	(³)
Asia:						
Burma.....	26,680	(³)	(³)	(³)	(³)	(³)
Chosen.....	(³)	(³)	(³)	(³)	(³)	(³)
India, British.....	3,166,087	3,153,165	3,245,177	3,269,070	2,697,789	(³)
Indochina.....	136,000	32,861	(³)	(³)	(³)	(³)
Japan.....	(³)	(³)	(³)	(³)	(³)	(³)
Malay States:						
Federated.....	780	972	(³)	(³)	(³)	(³)
Unfederated.....	1,991,173	1,872,903	(³)	(³)	(³)	(³)
Philippine Islands (ex-ports).....	1,154,738	1,191,641	¹² 852,080	(³)	(³)	(³)
Turkey.....	143,277	130,338	60,793	19,044	91,751	(³)
U. S. S. R. ⁹	(³)	(³)	(³)	(³)	(³)	(³)
Africa:						
Algeria.....	¹³ 2,750,000	(³)	326,802	306,549	183,572	787,768
Belgium Congo.....	(³)	6,100	13,000	9,000	23,964	(³)
Morocco:						
French.....	420,728	75,233	3,001	3,329	8,967	5,114
Spanish.....	¹⁴ 1,038,205	614,371	554,776	547,432	547,625	¹⁵ 675,868
Northern Rhodesia.....	138	271	271	(³)	(³)	(³)
Sierra Leone.....	(³)	(³)	¹⁶ 1,046,501	¹⁶ 643,241	517,727	(³)
South-West Africa.....	19,500	(³)	(³)	(³)	(³)	(³)
Tunisia.....	764,731	343,562	912	30,994	29,703	(³)
Union of South Africa.....	490,136	638,757	812,700	717,738	738,128	¹⁷ 375,821
Oceania:						
Australia:						
Queensland.....	4,003	2,887	2,349	3,815	(³)	(³)
South Australia.....	2,613,036	2,350,484	2,276,345	2,156,111	2,217,865	(³)
Tasmania.....	1,186	2,215	2,215	7	7	(³)
New Caledonia.....	83,567	176,600	(³)	-----	(³)	(³)
New Zealand.....	1,611	1,208	1,569	2,472	5,068	(³)
	199,000,000	¹⁸ 212,000,000	¹⁸ 233,000,000	¹⁸ 245,000,000	(³)	(³)

¹ In addition to the countries listed Argentina, China, Egypt, Eritrea, Finland, French West Africa, Madagascar, and New South Wales report production of iron ore, but complete data are not available.

² Production of Tofo mines. ³ Data not available. ⁴ Slovakia only. ⁵ Estimate included in total.

⁶ Exclusive of manganeseiferous iron ore carrying 12 to 30 percent manganese. ⁷ Estimate. ⁸ Exports.

⁹ U. S. S. R. in Asia included with U. S. S. R. in Europe. ¹⁰ Croatia only.

¹¹ Exclusive of bog ore, which is used mainly for purification of gas.

¹² January to July, inclusive. ¹³ January to June, inclusive.

REVIEW BY COUNTRIES

Canada.—Shipments of iron ore from Canadian mines totaled 498,635 gross tons in 1944. This quantity, included 482,083 tons of sinter from the Helen mine in the Michipicoten district and 16,552 tons of ore from the new Steep Rock mine on the Atikokan range of western Ontario. Steep Rock shipments in 1944 were from a United States port, but a new ore dock at Port Arthur is expected to be completed in time for the 1945 season when shipments from this mine will be greatly increased. A new operation is expected to be in production during 1944—the Josephine-Ruth property of Michipicoten Iron mines, Ltd. The Josephine will ship hematite, whereas siderite, similar to Helen ore, will be mined at the Ruth.

Chile.—The important iron-ore operation in Chile is the Tofo mine near La Serena, Province of Coquimbo. The output from this open-pit mine in 1944 totaled 663,879 gross tons compared with 294,684 tons in 1943. Of the 1944 production, 17,660 tons were shipped to blast furnaces at Corral near Valdivia, and the remainder was stock-piled.

Cuba.—In 1944, 27,922 gross tons of iron ore were produced from the Daiquiri open-cut mine in Oriente Province; all was stock-piled. For the 10-year period ended in 1941 annual shipments of iron ore from Cuba averaged 243,086 tons. This was reduced to 18,043 tons in 1942, when war shipping limitations prevented further movement of iron ore from Cuban ports. Stocks totaled 291,171 tons at the end of 1944 compared with 263,345 tons in 1943.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884-1944, in gross tons

Year	Juragua, Daiquiri, and Estancia (hematite and magne- tite)	Sagua (hematite)	Mayari (brown ore)	Guama (hematite)	El Cuero (hematite)	Total
1884-1942.....	22, 503, 074	20, 438	3, 988, 694	41, 241	903, 103	27, 456, 550
1943.....			96			96
1944.....	22, 503, 074	20, 438	3, 988, 790	41, 241	903, 103	27, 456, 646

Labrador.—A report of the field work done intermittently by the Hollinger Consolidated Gold Mines, Ltd., since 1936 has recently been made public.³ During 1944, diamond drilling was done at Sawyer Lake, situated 300 miles north of Seven Islands, a town on the Gulf of St. Lawrence. One hole, bottomed at 220 feet, was reported still in high-grade ore averaging 68.4 percent iron. Retty has estimated the quantity of ore at 30,000 tons per vertical foot.

At present the deposits are inaccessible, requiring the construction of a railroad 350 miles in length.

Mexico.—Imports of iron ore from Mexico totaled 62,630 gross tons in 1944.

One of the most important iron-ore deposits of Mexico is at Cerro de Mercado, just north of Durango. The reserves of ore available

³ Retty, J. A. Surface Work Indicates Possibility of a Major Iron Ore Field in Central Labrador: Min. and Met., vol. 26, No. 461, May 1946, p. 256.

have been estimated at 76,300,000 tons⁴ of hematite, martite, and magnetite. Production from this deposit to date has totaled approximately 2,000,000 metric tons. The maximum annual output (1942) was 160,180 tons. The ore is mined by open-pit methods and averages 62 percent iron, 0.5 percent phosphorus, and 0.5 percent sulfur. Most of the ore from this operation moves 386 miles to the steel plant of the Cia. de Fierro y Acero de Monterrey, S. A. A small tonnage is distributed among local consumers and the Texas Mining & Smelting Co.

North Africa.—The principal property in Spanish Morocco is the Minas del Rif, which lies about 13 miles southwest of Melilla. East of the Rif mines are the Minas de Setolazar, a substantial producing area but one that yields lower-grade ore. In Algeria good rail and shipping facilities exist, and large quantities of iron ore have been shipped in normal times from Bone, Beni Saf, Bougie, and Algiers. The most important operation in Algeria is the Ouenza mine 87 miles by rail from Bone and operated by the Soc. de l'Ouenza. A lumpy, low-phosphorus ore is shipped from the Timezrit mine 25 miles south of the port of Bougie. Iron ore shipped from Algiers comes from the Zaccar mines about 62 miles inland. Most of the Algerian ore consists of red and brown hematites rich in iron and low in silica. Some manganiferous ore is produced from the Rur-el Maden mine in western Oran.

⁴ Benitez, Alberto Terrones, Cerro de Mercado—Mexico's Iron Mountain: Eng. and Min. Jour., vol. 145, No. 9, September 1944, pp. 88-89.

By NORWOOD B. MELCHER AND JOHN HOZIK¹

SUMMARY OUTLINE

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GENERAL SUMMARY

The steel industry established a production record in 1944 that is likely to stand for many years. Output of steel ingots and castings totaled 89,641,600 net tons, compared with 88,836,512 tons in 1943. Plant expansion permitted this record steel production with an average operating rate of 96 percent of capacity compared with 98 percent in 1943. Pig-iron output in supporting this steel production also established a new record—excluding ferro-alloys it totaled 61,003,759 net tons. A 19-percent decrease in alloy steel production was largely due to declines in the lower-content grades so that the decline in the demand for ferro-alloys was less pronounced; a 7-percent decrease in production of ferro-alloys was recorded in 1944. The steel supply-demand relationship during 1944 was generally satisfactory, with the industry able to meet most military and highly essential civilian demands while operating at a rate slightly lower than the previous year.

Shipbuilding, although receiving 10 percent less steel, continued to be the leading consumer during 1944. Shipments to this industry totaled 10,287,299 net tons in 1944 compared with 11,508,809 tons in 1943. Miscellaneous industries and exports, largely arms production and lend-lease shipments, together received the largest share of the year's steel output, as in 1942 and 1943. Agriculture, railroads, and jobbers and dealers were allocated considerably more steel in 1944, receiving 57 percent, 20 percent, and 18 percent more steel than in

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

1943. Cut-backs in mobile equipment for the fighting forces resulted in a 20-percent decrease in steel shipments to the automotive and aircraft industries.

Total output of munitions in 1944 was valued at 63.7 billion dollars, an increase of 12 percent over 1943. However, advancements during the course of the year were small, and the over-all increase resulted from maintaining the high rate of output established in the final quarter of 1943. The largest increases in production were apparent in the aircraft industry. Total output of planes in 1944 numbered 96,356 compared with 85,930 in 1943; total weight of aircraft produced increased 47 percent over 1943. Next to aircraft, the largest increase was in the ammunition group. This change resulted from new demands among major types of ammunition, with particular emphasis

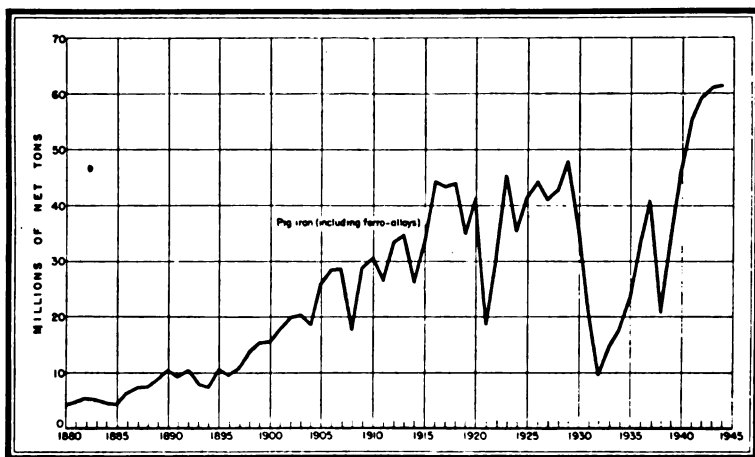


FIGURE 1.—Trend in production of pig iron in the United States, 1880-1944.

on aerial bombs. At the close of the year the stress was on heavy artillery, shells and rockets, and some small-arm lines. In the Navy program the trend was away from antisubmarine vessels to landing craft for the projected 1945 and 1946 offensives. Among the merchant types, the trend was from Liberty vessels to the faster cargo ships and to military types. Military vessels require a larger steel input per ton of ship capacity than the mass-produced Liberty ships. There was a sharp reduction in the combat and motor vehicle group in 1944, entirely due to the cut-backs in tanks, armored cars, and personnel carriers.

Employment in the iron and steel industry continued to drop during 1944. Total wage earners decreased from 503,000 in January to 474,000 in November. The average workweek increased, however, and was 46.6 hours in November compared with 45.6 hours in January. Average weekly earnings increased steadily from \$52.19 in January to \$54.55 in November.

Salient statistics of pig iron, ferro-alloys, and steel in the United States, 1943-44

	1943		1944	
	Net tons	Value	Net tons	Value
Pig iron:				
Production.....	60,765,195	(¹)	61,003,759	(¹)
Shipments.....	60,787,159	\$1,273,634,210	60,995,977	\$1,278,981,313
Average value per ton at furnace.....		20.95		20.97
Imports.....	1,445	41,408	5,778	116,408
Exports.....	144,269	4,291,281	162,478	4,307,389
Ferro-alloys:				
Production.....	2,032,979	(¹)	1,893,855	(¹)
Shipments:				
Ferromanganese.....	722,658	93,481,580	715,059	91,406,229
Spiegeleisen.....	150,136	4,827,954	155,325	4,851,490
Ferrosilicon.....	806,198	46,619,979	686,895	39,531,552
Other ferro-alloys.....	316,179	126,558,096	303,677	110,224,768
	1,995,171	271,487,609	1,860,956	246,014,039
Imports:				
Ferromanganese.....	2,302	160,600	4,199	394,641
Spiegeleisen.....	3,254	140,247	3,761	153,032
Ferrosilicon.....	10,546	156,077	22,646	750,153
Steel:				
Production:				
Open-hearth:				
Basic.....	77,207,870	(¹)	80,363,953	(¹)
Acid.....	1,413,934			
Bessemer.....	5,625,492		5,039,923	
Crucible.....	146		25	
Electric.....	4,589,070		4,237,699	
	88,836,512	(¹)	89,641,600	(¹)
Shipments to consuming industry.....	59,905,646	(¹)	60,352,690	(¹)

¹ Data not available.

POSTWAR OUTLOOK

A prospective decline in military requirements following V-E day will have a marked effect on steel-ingot production. During as early as the third and fourth quarters of 1945 it is anticipated that military and essential civilian requirements, although high, will center on fewer steel shapes. Virtual capacity operation of steel plants equipped to produce these items is expected, whereas plants not so equipped will be in an unsatisfactory position until they are able to convert to meet other civilian demands. Chief among products to be drastically curtailed is ship plate, which was extremely critical in the early days of the war,—a fact that led to the construction of 2,800,000 net tons of plate-rolling capacity during the war. Requirements for ship plate are expected to drop to approximately 10 percent of peak war-time output by the close of 1945. Shell steel and alloy steels will also be in considerably less demand during the second half of 1945. Increased demands for strip, sheet, and structures will aid the position of plants producing these products.

The automobile industry, steel's leading prospective customer for the postwar period, was making preparations in 1944 for the tremendous task of reconverting to meet civilian requirements from 100 percent war production. Shortly after V-E day, the industry was given permission to produce a limited number of passenger cars during the last half of 1945—the first output since March 1942. As of June 1945 only about 215,000 units were planned for 1945, but it was anticipated that production will reach a rate of 2 to 3 million automobiles

per year by the close of 1946. Peak automobile production of 5 million units in prewar years required 7 million net tons of steel products, or about 10 million tons converted to ingots. This rate of operation is virtually a certainty as a minimum for the immediate postwar years.

The railroads, with plans to invest 1,750 million dollars in rolling stock and a similar amount in other facilities during the 5 post-V-E years, will rival the automobile industry as a consumer of steel. Railroads received 5.4 million tons of steel products in 1944 compared with 4.5 million tons in 1943 and 3.8 million in 1940. Light metals will enter this field to some extent in the manufacture of lightweight freight and passenger cars, but the total tonnage of steel that will be thus displaced will be relatively small.

The construction industry has a backlog of \$10.5 billion awaiting the relaxation of manpower and materials restrictions. Approximately \$4 billion will be expended during 1945 according to recent War Production Board estimates. This industry received 4.5 million tons of steel products in 1944, and postwar requirements will probably exceed this figure.

The container industry, which in 1944 used 3.7 million tons of steel products, largely tin and terne plate, will continue to be a large consumer, with requirements virtually unchanged.

Production of essential civilian items such as farm machinery, trucks, locomotives, and mining equipment, which has already been stepped up will accelerate during continuation of the Japanese War.

Manufacturers of such consumer appliances as electric irons, washing machines, stoves, and kitchen appliances, some of which are being produced in limited quantities, will be pressed to capacity following V-J day to meet postponed civilian requirements.

Summarizing steel made available by cut-backs in war-material output will be diverted to civilian production as fast as and to the extent that fabricating industries are able to absorb it. However, it is not expected that such industries will be able to use a tonnage approaching that required during World War II. Nor is it anticipated that requirements for steel will revert to the prewar (1935-39) level of 46,574,000 tons. The rate at which steel furnaces will be producing at the close of the war in Asia will depend largely on how soon hostilities terminate there. The annual production of steel ingots and castings for the 5 years following Japan's capitulation will probably average about 60 million net tons. At this rate, the pig-iron requirements for iron and steel furnaces would approximate 40 million tons.

PIG IRON

PRODUCTION AND SHIPMENTS

Domestic production of pig iron in 1944, exclusive of ferro-alloys, increased slightly (less than 0.5 percent) over 1943 to establish a new record. The output in 1944 comprised 60,944,293 net tons using coke and 59,466 using charcoal as fuel. Pennsylvania was the largest producer of pig iron in 1944 with 30 percent of the total; Ohio ranked second with 22 percent.

Pig iron produced and shipped in the United States, 1943-44, by States

State	Produced		Shipped from furnaces			
	1943	1944	1943		1944	
	Net tons	Net tons	Net tons	Value	Net tons	Value
Alabama.....	3, 779, 860	3, 949, 172	3, 811, 987	\$66, 151, 938	3, 936, 471	\$68, 239, 438
California.....	296, 174	353, 682	261, 109		384, 528	
Colorado.....	967, 190	1, 363, 908	967, 426	22, 649, 456	1, 358, 949	33, 192, 725
Utah.....						
Illinois.....	5, 950, 430	5, 685, 533	5, 920, 894	126, 910, 295	5, 686, 397	118, 953, 078
Indiana.....	6, 713, 101	6, 860, 642	6, 722, 066	150, 497, 458	6, 867, 453	153, 676, 643
Kentucky.....	706, 253	728, 588	706, 253	(1)	728, 588	(1)
Maryland.....	2, 526, 636	2, 515, 049	2, 526, 748	(1)	2, 514, 735	(1)
Massachusetts.....	(1)	(1)	(1)	(1)	(1)	(1)
Michigan.....	1, 480, 226	1, 621, 979	1, 492, 942	24, 782, 464	1, 617, 912	(1)
Minnesota.....	582, 854	571, 185	532, 761	(1)	566, 775	(1)
New York.....	3, 947, 018	3, 832, 192	3, 953, 492	79, 873, 775	3, 836, 078	76, 575, 005
Ohio.....	13, 724, 885	13, 373, 397	13, 750, 856	299, 483, 340	13, 400, 053	294, 265, 267
Pennsylvania.....	18, 571, 286	18, 507, 068	18, 593, 220	399, 568, 279	18, 503, 427	397, 395, 665
Tennessee.....	(1)	(1)	(1)	(1)	(1)	(1)
Texas.....		150, 015			137, 566	2, 646, 769
Virginia.....	(1)	(1)	(1)	(1)	(1)	(1)
West Virginia.....	1, 331, 777	1, 355, 333	1, 335, 331	(1)	1, 355, 784	(1)
Undistributed ¹	237, 005	145, 926	222, 075	103, 717, 205	112, 261	134, 086, 723
	60, 765, 195	61, 003, 759	60, 787, 159	1, 273, 634, 210	60, 995, 977	1, 278, 981, 313

¹ Included under "Undistributed."

² Includes statistics for States entered as "(1)"

Shipments of pig iron, exclusive of ferro-alloys, also increased only slightly in quantity and value in 1944 over 1943. The values given represent the approximate amounts received for the iron f. o. b. furnaces and do not include freight costs, selling commissions, and other items figured in some of the market prices for pig iron published by trade journals.

Pig iron shipped from blast furnaces in the United States, 1943-44, by grades

Grade	1943			1944		
	Net tons	Value		Net tons	Value	
		Total	Average		Total	Average
Charcoal.....	72, 943	\$2, 215, 491	\$30. 37	55, 705	\$1, 652, 378	\$29. 66
Foundry.....	2, 257, 323	45, 774, 319	20. 28	2, 405, 222	48, 134, 381	20. 01
Basic.....	45, 493, 932	933, 281, 686	20. 51	46, 289, 976	953, 105, 181	20. 56
Bessemer.....	10, 005, 722	222, 395, 136	22. 23	9, 278, 387	207, 628, 157	22. 38
Low-phosphorus.....	575, 473	15, 363, 819	26. 70	486, 362	13, 089, 619	26. 91
Malleable.....	2, 126, 771	48, 964, 793	23. 04	2, 145, 823	48, 915, 065	22. 80
All other (not ferro-alloys).....	254, 995	5, 606, 957	22. 00	334, 502	6, 456, 532	19. 30
	60, 787, 159	1, 273, 634, 210	20. 95	60, 995, 977	1, 278, 981, 313	20. 97

The number of furnaces in blast June 30 and December 31 and the total number of furnaces recorded for 1942 and 1943 were as follows:

*Blast furnaces (including ferro-alloy blast furnaces) in the United States, 1943-44*¹

State	In blast June 30, 1943	December 31, 1943			In blast June 30, 1944	December 31, 1944		
		In	Out	Total		In	Out	Total
Alabama.....	20	20	1	21	19	19	1	20
California.....	1	1	1	1	1	1	1	1
Colorado.....	3	3	1	4	3	3	1	4
Illinois.....	21	21	1	21	19	20	2	22
Indiana.....	18	20	1	20	20	19	1	20
Kentucky.....	3	3	1	3	3	3	1	3
Maryland.....	7	7	1	7	7	7	1	7
Massachusetts.....	1	1	1	1	1	1	1	1
Michigan.....	6	6	1	6	5	6	1	6
Minnesota.....	3	3	1	3	3	3	1	3
New York.....	16	17	1	17	15	14	3	17
Ohio.....	46	48	2	50	48	44	6	50
Pennsylvania.....	66	70	8	78	69	67	9	76
Tennessee.....	4	3	1	4	2	2	2	4
Texas.....	1	1	1	1	1	1	1	2
Utah.....	1	2	3	5	3	4	1	5
Virginia.....	1	1	1	1	1	1	1	1
West Virginia.....	3	4	1	4	4	4	1	4
	220	230	17	247	224	218	28	246

¹ American Iron and Steel Institute.

CONSUMPTION OF METALLIFEROUS RAW MATERIALS

The production of pig iron in 1944 required 109,531,216 tons of iron ore, sinter, and manganiferous iron ore, 3,544,025 tons of mill cinder and roll scale, 3,518,855 tons of open-hearth and Bessemer slag, 2,135,498 tons of purchased scrap, 146 tons of pyrite cinder, and 49,901 tons of miscellaneous material, an average of 1,947 tons of metalliferous materials (exclusive of home scrap and flue dust) per ton of pig iron made.

Of the pig iron manufactured in 1944, it is calculated that 119,120 tons valued at \$2,405,500 were made from 255,449 tons of foreign ores, including ore from Africa, Canada, Cuba, Mexico, and Sweden, indicating an average yield of 46.63 percent from imported ore. Domestic ore and sinter (109,374,151 tons) and other materials (9,248,425 tons) totaling 118,622,576 tons were reported as used in the manufacture of 60,884,639 tons of pig iron, indicating an average pig-iron yield of 51.33 percent from domestic materials. In addition, 1,519,226 tons of home scrap and 129,166 tons of flue dust were consumed in making pig iron in 1944.

The iron ore used in Alabama (all domestic) in 1944 was mainly hematite from mines in Jefferson County. However, brown ore from Alabama and Georgia also was used. In addition, ferruginous manganese ore of both domestic and Cuban origin, amounting to 21,451 and 1,844 tons, respectively, was used. Because the average grade of ores used in Alabama is low, furnaces in this State use more ore per ton of pig iron than any other district in the United States.

The iron ore used in Fontana, Calif., furnace was hematite supplied by the Vulcan mine in San Bernardino County, Calif. Manganese-bearing ore of both domestic and Mexican origin also was used.

Iron ore and other metallic materials consumed and pig iron produced, 1943-44, by States, in net tons

State	Metalliferous materials consumed				Materials consumed per ton of pig iron made					
	Iron and manganese iron ores		Sinter	Miscellaneous ¹	Total	Pig iron produced	Ores	Sinter	Miscellaneous	Total
	Domestic	Foreign								
1943										
Alabama.....	7,631,359	9,509	1,799,179	121,731	9,561,778	3,779,860	2.021	0.476	0.032	2.529
California.....	1,898,351	11,512	473,282	38,782	2,421,927	1,265,364	1.509	.374	.031	1.914
Colorado.....										
Utah.....										
Illinois.....	10,198,552		723,436	664,142	11,586,130	5,950,430	1.714	.121	.112	1.947
Indiana.....	11,699,413		933,619	1,050,334	13,683,366	6,713,101	1.743	.139	.150	2.038
Kentucky.....	1,224,150		22,432	122,361	1,368,943	706,253	1.733	.032	.173	1.938
Maryland.....	3,559,983	14,342	324,471	893,146	4,791,942	2,525,636	1.415	.128	.354	1.897
Michigan.....	2,477,034		306,619	91,452	2,875,105	1,480,226	1.673	.207	.062	1.942
Minnesota.....	1,027,432		13,545	58,665	1,099,642	532,354	1.930	.025	.110	2.065
New York.....	6,601,782	80,274	783,855	381,159	7,847,070	3,947,018	1.693	.198	.097	1.988
Ohio.....	20,119,170		3,838,961	2,242,771	26,200,902	13,724,885	1.466	.280	.163	1.909
Pennsylvania.....	27,592,123	23,816	3,646,774	3,566,522	34,829,235	18,571,286	1.487	.196	.192	1.875
Massachusetts.....	317,485	21,949	46,942	35,629	422,005	237,005	1.432	.198	.151	1.781
Tennessee.....										
Virginia.....										
West Virginia.....	2,311,335		68,898	100,237	2,480,470	1,331,777	1.736	.052	.075	1.863
	96,658,169	161,402	12,982,013	9,366,931	119,168,515	60,765,195	1.593	.214	.154	1.961
1944										
Alabama.....	7,460,510	1,844	1,988,494	180,177	9,661,025	3,949,172	1.897	.504	.046	2.445
California.....	2,079,786	11,369	995,416	80,446	3,167,017	1,717,680	1.217	.580	.047	1.844
Colorado.....										
Utah.....										
Illinois.....	9,425,135		718,680	815,810	10,959,625	5,685,533	1.658	.126	.143	1.928
Indiana.....	11,689,304		1,063,556	856,404	13,609,264	6,850,642	1.706	.155	.125	1.987
Kentucky.....	1,169,976		40,571	200,324	1,410,871	728,588	1.606	.056	.275	1.936
Maryland.....	3,081,872	8,174	993,741	708,488	4,792,275	2,515,049	1.229	.395	.281	1.905
Michigan.....	2,776,341		220,801	129,709	3,126,851	1,621,979	1.712	.136	.080	1.928
Minnesota.....	975,872		88,564	68,282	1,132,718	571,185	1.709	.155	.120	1.983
New York.....	6,222,288	53,076	776,636	406,100	7,458,100	3,832,192	1.638	.203	.106	1.946
Ohio.....	19,231,953		4,124,907	2,034,877	25,391,737	13,373,397	1.438	.308	.152	1.899
Pennsylvania.....	27,094,019	12,874	4,244,391	3,617,864	34,969,148	18,507,068	1.415	.229	.195	1.890
Texas.....	247,560	61,517			309,077	150,015	2.060			2.060
West Virginia.....	2,301,250	8,211	99,555	129,407	2,538,423	1,355,333	1.704	.073	.095	1.872
Massachusetts.....	186,154		46,819	20,537	253,510	145,926	1.276	.321	.141	1.737
Tennessee.....										
Virginia.....										
	93,972,020	157,065	15,402,131	9,248,425	118,779,641	61,003,759	1.543	.252	.152	1.947

¹ Excludes recycled materials.

Maryland furnaces consumed chiefly domestic ore in 1944, but some iron ore from Africa and pyrite cinder of both domestic and foreign origin were used. These furnaces have a low consumption of ore per ton of pig; however, they used proportionately more miscellaneous materials than any other State.

Blast furnaces in Illinois, Indiana, Kentucky, Michigan, Minnesota, and West Virginia used Lake Superior iron ore and manganese ferrous iron ore almost exclusively.

In New York the furnaces in the Buffalo district used ore from the Lake Superior district and Canada, and magnetite from New York; the furnace at Troy consumed magnetite sinter from the Chateaugay mine at Lyon Mountain, N. Y.

Foreign iron and manganiferous iron ore consumed in the manufacture of pig iron in the United States, 1943-44, by sources of ore, in net tons

Source	1943	1944	Source	1943	1944
Africa.....	36,034	21,048	Mexico.....	11,512	72,886
Australia.....			Newfoundland.....	23,035	
Brazil.....			Spain.....	336	
Canada.....	78,745	61,287	Sweden.....	702	
Chile.....			Source not stated.....		
Cuba.....	11,038	1,844	Total.....	161,402	157,065
India.....					

Ohio blast furnaces consumed magnetite sinter from New York in addition to hematite from the Lake Superior district.

Virtually all the ore consumed in western Pennsylvania furnaces came from the Lake Superior district. Those in the eastern part of the State used some Lake ore, some magnetite ores from Pennsylvania, New Jersey, and New York, and some ore from Africa.

The Colorado furnaces used hematite from the Sunrise mine in Wyoming, semialtered magnetite from the Duncan mine (Utah), and magnetite and manganese-bearing ores from New Mexico.

The Provo, Utah, furnace used semialtered magnetite from the Iron Mountain mine near Cedar City, Utah, and manganese-bearing ores, chiefly from Nevada and Utah. The sinter used was produced at Geneva and Provo from Iron Mountain fine ore.

VALUE AT BLAST FURNACES

The average value of all grades of pig iron given in the following table is based upon reports of producers to the Bureau of Mines. The figures represent the values f. o. b. blast furnaces and do not include the values of ferro-alloys. The general average value for all grades of pig iron at the furnaces was \$20.97 a net ton in 1944—virtually unchanged from 1943.

Average value per net ton of pig iron at blast furnaces in the United States, 1939-44, by States

State	1939	1940	1941	1942	1943	1944
Alabama.....	\$14.42	\$14.30	\$17.25	\$17.30	\$17.35	\$17.34
Illinois.....	18.02	18.05	20.79	21.40	21.43	20.92
Indiana.....	18.03	18.26	21.22	22.17	22.39	22.41
Michigan.....	14.79	13.78	15.72	15.35	16.60	17.21
New York.....	18.29	16.89	17.91	19.63	20.20	19.96
Ohio.....	18.12	18.81	20.67	21.64	21.78	21.96
Pennsylvania.....	18.52	19.40	21.07	21.51	21.49	21.48
Western States.....	(1)	(1)	(1)	(1)	* 18.59	* 19.04
Other States ¹	14.91	15.20	18.62	19.09	* 19.48	* 20.10
Average for United States.....	17.44	17.90	20.13	20.77	20.95	20.97

¹ Colorado and Utah included with other States.

* California, Colorado, and Utah.

² Includes States entered as "(1)" and Iowa, Kentucky, Maryland, Massachusetts, Minnesota, Tennessee, Texas, Virginia, and West Virginia.

³ Excludes Iowa.

COMMERCIAL QUOTATIONS

The average monthly prices of Foundry, Basic, and Bessemer pig iron at Valley furnaces and of Foundry pig iron at Birmingham

furnaces, according to published market quotations, are summarized in the following tables:

*Average monthly prices per net ton of chief grades of pig iron, 1943-44*¹

Month	Foundry pig iron at Valley furnaces		Foundry pig iron at Birmingham furnaces		Bessemer pig iron at Valley furnaces		Basic pig iron at Valley furnaces	
	1943	1944	1943	1944	1943	1944	1943	1944
January.....	\$21.43	\$21.43	\$18.20	\$18.20	\$21.88	21.88	\$20.98	\$20.98
February.....	21.43	21.43	18.20	18.10	21.88	21.88	20.98	20.98
March.....	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
April.....	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
May.....	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
June.....	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
July.....	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
August.....	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
September.....	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
October.....	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
November.....	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
December.....	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98
Average.....	21.43	21.43	18.20	18.20	21.88	21.88	20.98	20.98

¹ Metal Statistics, 1945.

FOREIGN TRADE

*Pig iron imported for consumption in the United States, 1940-44, by countries, in net tons*¹

Country	1940	1941	1943	1944
North America: Canada.....	3,826	308	49	5,778
Europe: United Kingdom ¹			560	
Asia: India and Dependencies.....	7,645		500	
Oceania: Australia.....		3,367	336	
Value.....	11,471 \$189,379	3,675 \$61,130	1,445 \$41,408	5,778 \$116,408

¹ None imported in 1942.

¹ United Kingdom of Great Britain and Northern Ireland.

Pig iron exported from the United States, 1943-44, by countries, in net tons

Country	1943	1944	Country	1943	1944
North America:			Europe:		
Canada.....	7,604	8,949	Portugal.....	4,171	1,936
Cuba.....	55	544	U. S. S. R.....	3,727	4,028
Iceland.....	231	111	United Kingdom ¹	121,317	131,888
Jamaica.....	141	112	Other Europe.....	112	528
Other North America.....	136	180	Asia: India and Dependencies.....	57	
South America:			Africa:		
Argentina.....	431		Algeria.....	1,539	2,961
Bolivia.....	100	147	Belgian Congo.....	395	
Chile.....	1,228	2,332	French West Africa.....	326	1
Colombia.....	150	2,886	Morocco, French.....	418	1,122
Peru.....	870	1,665	Other Africa.....	14	419
Uruguay.....	1,202	2,555			
Other South America.....	45	114			
			Value.....	144,269 \$4,291,281	162,478 \$4,307,389

¹ United Kingdom of Great Britain and Northern Ireland.

CONSUMPTION

Consumption of pig iron in 1944 increased 1 percent over 1943. Pig iron, a product of the blast furnace, is a semiraw material and, except for the small quantity used in direct castings, moves to steel- or iron-melting furnaces for further refining alone or mixed with other ingredients. In 1944, 89 percent of the pig iron went to steel-making furnaces (open-hearth, bessemer, and electric) to be processed into steel. Direct castings took 4 percent of the 1944 total, and the remaining 7 percent was consumed in iron-making furnaces, of which the cupola is the most important. The consumption of pig iron, by types of furnace, for 1941 to 1944 is shown in the following table. The quantities of pig iron used in these furnaces are supplemented by the addition of ferrous scrap. The proportion of pig iron to scrap used in steel furnaces increased in 1944 over 1943.

Consumption of pig iron in the United States, 1941-44, by type of furnace

Type of furnace or equipment	1941		1942		1943		1944	
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total
Open-hearth.....	42,481,404	75.6	45,538,846	77.1	47,107,608	78.1	48,281,168	79.2
Bessemer.....	5,993,264	10.7	6,131,222	10.4	6,257,927	10.4	5,583,027	9.2
Electric.....	72,758	.1	92,878	.2	393,819	.6	240,482	.4
Cupola ¹	5,388,747	9.6	4,490,532	7.6	3,602,918	6.0	3,941,159	6.5
Air.....	604,835	1.1	555,436	.9	537,902	.9	499,457	.8
Brackelsberg.....								
Crucible.....	207	(²)	221	(²)	457	(²)	863	(²)
Puddling.....	54,183	.1	49,835	.1	38,231	.1	28,166	(¹)
Direct castings ¹	1,590,074	2.8	2,183,913	3.7	2,376,297	3.9	2,377,299	3.9
	56,185,472	100.0	59,042,883	100.0	60,315,159	100.0	60,951,621	100.0

¹ Some pig iron used in making direct castings included in cupola.

² Less than 0.05 percent.

Plants using pig iron are situated in all 48 States, the District of Columbia, and Alaska. As expected from the uses of pig iron, consumption is concentrated largely in the steel-making centers of the North Central, Middle Atlantic, and Southeastern States. These areas in 1944 used about 97 percent of the pig iron, Pennsylvania (the leading consumer) taking about 31 percent of the total and Ohio (the second-largest consumer) 20 percent.

Consumption of pig iron in the United States, 1941-44, by States and districts

State and district	1941		1942		1943		1944	
	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons
Connecticut.....	62	143,862	61	138,938	56	113,588	57	101,816
Maine.....	14	11,467	13	8,763	14	6,133	15	6,543
New Hampshire.....	15	5,816	16	20,523	15	5,830	16	6,785
Massachusetts.....	107	242,265	101	244,993	103	225,465	104	192,870
Rhode Island.....	12	57,082	12	58,116	12	46,756	12	39,858
Vermont.....	14	16,276	12	20,653	13	14,751	13	12,057
Total New England.....	224	476,768	215	491,986	213	412,523	217	359,929
Delaware.....	7		7		7		7	
New Jersey.....	80	449,486	84	532,783	77	415,936	74	355,486
New York.....	199	2,765,216	200	3,015,417	198	3,032,096	194	2,958,342
Pennsylvania.....	391	17,573,102	392	18,843,804	375	19,367,283	380	19,095,662
Total Middle Atlantic.....	677	20,787,804	683	22,392,004	657	22,815,315	655	22,409,490
Alabama.....	74	3,142,958	71	3,408,958	68	3,101,043	67	3,263,647
District of Columbia.....	1		1		1		1	
Kentucky.....	23	2,974,834	23	3,055,553	23	3,156,432	24	3,185,611
Maryland.....	26		28		21		22	
West Virginia.....	28	1,218,175	27	1,624,014	28	1,748,020	25	1,671,046
Florida.....	12		15		18		19	
Georgia.....	43	83,895	44	81,229	45	88,719	49	89,835
Mississippi.....	7	621	6	615	6	576	6	903
North Carolina.....	40	18,591	42	16,076	42	13,464	46	18,092
South Carolina.....	12	5,090	14	4,532	15	4,610	17	4,779
Tennessee.....	52		51		52		54	
Virginia.....	45	254,840	47	165,331	51	134,878	49	162,913
Total Southeastern.....	363	7,699,004	369	8,356,308	370	8,247,742	379	8,396,796
Arkansas.....	6		3		3		5	
Oklahoma.....	7	2,600	7	3,053	10	4,098	13	6,826
Louisiana.....	7		6		7		12	
Texas.....	27	3,107	28	4,428	40	23,715	45	152,058
Total Southwestern.....	47	5,707	44	7,481	60	27,813	75	158,884
Illinois.....	208	4,915,372	212	5,369,942	208	5,266,187	209	5,158,045
Indiana.....	131	6,833,091	127	6,963,040	126	7,218,967	131	7,453,187
Iowa.....	52	104,368	54	64,012	51	68,883	55	103,055
Minnesota.....	53	266,768	57	308,937	59	412,853	58	443,943
Missouri.....	51	80,065	53	81,677	53	123,124	59	130,537
Kansas.....	15		11		14		21	
Nebraska.....	10	4,251	10	5,882	11	6,682	12	10,381
Michigan.....	174		175		172		178	
Wisconsin.....	111	2,478,219	114	2,104,082	112	2,098,447	110	2,332,201
North Dakota.....	2	86	2	76	1	210	1	412
South Dakota.....	2		2		2		1	
Ohio.....	319	11,676,773	325	11,958,323	324	12,410,067	335	12,271,656
Total North Central.....	1,126	26,358,993	1,140	26,855,971	1,133	27,605,420	1,170	27,903,417
Arizona.....	2	67	2	36	2	81	3	91
Nevada.....								
New Mexico.....								
Colorado.....	18	644,393	18	666,254	16	721,672	20	1,082,544
Utah.....								
Idaho.....								
Wyoming.....	4	578	5	648	4	468	3	367
Montana.....								
Total Rocky Mountain.....	24	645,038	25	666,938	22	722,221	26	1,083,002
Oregon.....	18	9,830	17	17,178	21	35,699	33	39,614
Washington.....	33		30		38		37	
California.....	98	202,328	93	255,017	114	448,426	128	600,489
Total Pacific Coast.....	149	212,158	140	272,195	173	484,125	198	640,103
Total United States.....	2,610	56,185,472	2,616	59,042,883	2,628	60,315,159	2,720	60,951,621

WORLD PRODUCTION

The following table shows the production of pig iron, by countries, from 1939 to 1944, insofar as statistics are available.

World production of pig iron (including ferro-alloys), 1939-44, by countries, in metric tons¹

[Compiled by B. B. Waldbauer]

Country ¹	1939	1940	1941	1942	1943	1944
Australia ²	1,122,334	1,231,459	(?)	(?)	(?)	(?)
Belgian Congo.....	⁴ 600	⁴ 600	(?)	(?)	(?)	(?)
Belgium.....	3,058,730	² 2,200,000	(?)	(?)	(?)	(?)
Brazil.....	160,016	185,570	208,795	213,619	247,680	294,573
Canada.....	845,461	1,323,128	1,579,648	1,985,500	1,793,451	1,846,162
China.....	⁴ 700,000	⁴ 700,000	¹ 1,380,000	² 2,400,000	⁷ 84,301	⁷ 40,134
Chosen.....	⁴ 200,000	⁴ 200,000	(?)	(?)	(?)	(?)
Czechoslovakia.....	¹ 1,000,000	(?)	(?)	(?)	(?)	(?)
Finland.....	⁴ 30,000	(?)	(?)	(?)	(?)	(?)
France.....	⁴ 7,900,000	² 4,600,000	(?)	(?)	(?)	(?)
Germany ¹⁰	¹ 20,300,000	² 21,000,000	(?)	(?)	(?)	(?)
Austria.....			(?)	(?)	(?)	(?)
Hungary.....	² 460,000	(?)	(?)	(?)	(?)	(?)
India, British.....	1,785,242	2,026,241	2,042,123	1,859,108	1,776,941	(?)
Italy.....	1,095,785	³ 890,000	(?)	(?)	(?)	(?)
Japan.....	⁴ 3,000,000	² 3,000,000	(?)	(?)	(?)	(?)
Luxemburg.....	¹ 1,800,000	¹ 1,000,000	(?)	(?)	(?)	(?)
Mexico.....	141,335	93,179	108,524	106,509	147,059	134,632
Netherlands.....	284,004	(?)	(?)	(?)	(?)	(?)
Norway.....	190,785	(?)	(?)	(?)	(?)	(?)
Poland.....	¹ 1,000,000	(?)	(?)	(?)	(?)	(?)
Rumania.....	⁴ 140,000	¹ 122,227	(?)	(?)	(?)	(?)
Spain.....	473,360	588,076	545,148	549,030	697,318	571,335
Sweden.....	691,402	787,211	749,470	770,773	780,000	(?)
Turkey.....	(?)	81,248	86,057	67,350	55,259	69,000
Union of South Africa.....	300,227	303,923	360,000	362,800	486,800	471,520
U. S. S. R.....	¹ 15,200,000	¹ 15,200,000	⁴ 13,100,000	⁴ 7,075,000	(?)	(?)
United Kingdom.....	8,108,100	8,336,700	7,510,600	7,726,000	7,302,400	(?)
United States.....	32,321,653	43,026,030	51,456,627	55,316,075	56,969,248	57,059,457
Yugoslavia.....	61,106	(?)	¹¹ 75,000	(?)	(?)	(?)
	102,370,140	108,187,600	(?)	(?)	(?)	(?)

¹ Pig iron is produced in Chile, New Zealand, Philippine Islands and Switzerland, in addition to countries listed, but production figures are not available.

² Year ended June 30.

³ Data not available; estimate included in total for 1940.

⁴ Estimate.

⁵ Approximate production as published by Iron Age, vol. 147, No. 1, Jan. 2, 1941, p. 61.

⁶ Estimated production includes Manchuria.

⁷ Unoccupied China.

⁸ Approximate production as published by Steel, vol. 196, No. 1, January 1940, p. 269.

⁹ Included in German figure in 1940.

¹⁰ Beginning with March 1935, production of the Saar included with that of Germany.

¹¹ Croatia only.

FERRO-ALLOYS

PRODUCTION AND SHIPMENTS

The production of ferro-alloys in 1944 totaled 1,893,855 net tons compared with 2,032,979 tons in 1943—a decrease of 7 percent. In 1944 ferro-alloys were made at 15 blast-furnace plants, 27 electric-furnace plants, and 3 aluminothermic plants. The 27 electric-furnace plants include 5 plants that made ferrophosphorus and 2 plants that made ferrosilicon as a byproduct. Shipments of all classes of ferro-alloys in 1944 decreased 5 percent in quantity and 9 percent in value from 1943. Pennsylvania was by far the largest producer and shipper of ferro-alloys in 1944, both in tonnage and value. Of the ferro-alloys shipped in 1944, Pennsylvania contributed 37 percent of the total tonnage and 45 percent of the total value; New York was second, with 17.4 percent of the tonnage and 22.6 percent of the value.

Ferro-alloys produced and shipped from furnaces in the United States, 1943-44

Alloy	1943				1944			
	Production (net tons)	Shipments		Value	Production (net tons)	Shipments		Value
		Net tons	Value			Net tons	Value	
Ferromanganese.....	702,494	722,658	\$93,481,580		702,632	715,059	\$91,406,229	
Spiegeleisen.....	149,036	150,136	4,827,954		165,530	155,325	4,851,490	
Ferrosilicon.....	818,351	806,198	46,619,979		700,358	686,895	39,531,552	
Ferrophosphorus.....	37,762	6,344	404,611		31,428	7,504	473,084	
Ferromanganese.....	7,561	7,403	22,090,310		6,696	6,911	19,764,068	
Ferrotitanium.....								
Ferrovandium.....	16,772	16,523			14,986	14,669		
Ferromolybdenum.....								
Metallurgical.....								
Calcium molybdate and compounds.....	37,727	33,603	104,063,175		23,339	25,279	89,987,616	
Other varieties.....	263,286	252,306			248,886	249,314		
	2,032,979	1,995,171	271,487,609		1,893,855	1,860,956	246,014,039	

¹ Silicomanganese, manganese briquets, ferrochromium, ferrocolumbium, ferroboreon, zirconium-ferro-silicon, and alsifer; also chrome-manganese in 1943 and grainals and stiminal in 1944.

Ferromanganese.—The output of ferromanganese in 1944 averaged 78.62 percent manganese and came from nine blast-furnace plants and two electric-furnace plants. Of the manganese ore used in 1944 in the manufacture of ferromanganese, 90.3 percent was from foreign sources. During 1944 steel producers used 13.2 pounds of metallic manganese as ferro-alloys per ton of steel produced. Of this quantity, 11.7 pounds were in the form of ferromanganese. A total of 730,491 tons of ferromanganese was consumed during the year—virtually all by the iron and steel industry. A detailed discussion of manganese alloys is contained in the chapter on Manganese.

Spiegeleisen.—In 1944, 165,530 net tons of spiegeleisen, averaging 19.6 percent manganese, were produced; all was made in blast furnaces. This represents an increase of 11 percent over 1943. Shipments in 1944 were 155,325 tons valued at \$4,851,490. The average price of spiegeleisen, f. o. b. furnaces, was \$31.23 per net ton in 1944 compared with \$32.16 in 1943.

Ferrosilicon.—Ferrosilicon, including silvery pig iron, is one of the major products of the ferro-alloys industry both with reference to tonnage produced and dollar value. Of the 700,358 net tons of ferrosilicon produced in 1944, 255,399 tons were produced in blast furnaces, 444,215 tons in electric furnaces, and 744 tons as a by-product in the manufacture of artificial abrasives in electric furnaces. The silicon content of the output in 1944 ranged from 9 to 95 percent and averaged 31.2 percent. Blast-furnace production averaged about 10 percent silicon. A break-down of the ferrosilicon and silvery pig iron produced in 1944, by grades, shows that 56 percent (392,483 tons) contained 9 to 16 percent silicon, 31 percent (217,939 tons) averaged 25 to 50 percent silicon, 11 percent (74,749 tons) averaged 71 to 80 percent silicon, and 2 percent (15,187 tons) was made up mostly of grades higher than 80 percent in silicon. Shipments of all grades of ferrosilicon in 1944 amounted to 686,895 tons valued at \$39,531,552.

Ferrosilicon has many uses. In the steel industry, the most important consumer, ferrosilicon is used as a deoxidizer and degasifier to reduce blowholes and to produce sound steel. The 15-percent grade (silvery pig iron) is used as a furnace deoxidizer and scavenger prior to the use of more expensive alloys. Fifty-percent ferrosilicon, the

most commonly used grade, serves primarily as a deoxidizer in the manufacture of practically all kinds of steel, whereas the 75-percent grade is used extensively in the manufacture of steels for automobile and railway springs where a relatively high silicon content is desirable. When large additions of silicon are made to steel, ferrosilicon in the most concentrated form (80 to 95 percent silicon) is employed so as to avoid the chilling effect of adding large masses of cold alloy to the molten metal.

Other significant uses of ferrosilicon are in the (1) manufacture of iron castings (silvery pig iron), (2) manufacture of magnesium (75 percent ferrosilicon), (3) manufacture of hydrogen (85 percent ferrosilicon), and (4) beneficiation of low-quality ores (15-percent ferrosilicon). In the beneficiation process, finely ground 15-percent ferrosilicon is added to water and agitated—the resulting fluid floats a part of the feed, which may be either the valuable portion or the waste.

Ferrosilicon is made of domestic raw materials. To produce 1 net ton of standard (50-percent) ferrosilicon the following materials and power are required: 45 to 55 pounds of electrodes, 1,000 pounds of steel scrap, 1,300 pounds of coke, 2,000 pounds of quartz, and 5,000 kilowatt-hours of electrical energy. The amounts of materials vary in making other grades. Steel scrap is required in proportionately less amounts in the higher-silicon alloys, whereas the amount of coke, quartz, and power required increases rapidly as the silicon content increases. Approximately double the amount of these three is required to produce 75-percent ferrosilicon as is required to produce 50-percent.

Ferrophosphorus.—All ferrophosphorus in 1944 was produced as a byproduct of the electric furnaces in the manufacture of phosphate fertilizers and other chemicals. Shipments amounted to 7,504 net tons valued at \$473,084.

Ferrotungsten.—Production of ferrotungsten dropped from 7,561 net tons in 1943 to 6,696 tons in 1944—a decrease of 11 percent. Shipments in 1944 contained 76.77 percent (10,611,482 pounds) of tungsten and were valued at \$1.863 per pound of contained metal. All ferrotungsten was produced in electric furnaces. Both foreign and domestic ores were used in 1944.

Ferrochromium.—The industrial consumers of ferrochromium reported using 159,911 net tons of ferrochromium in 1944 compared with 183,019 tons in 1943 and 162,904 tons in 1942.

Ferromolybdenum.—The bulk of the ferromolybdenum produced in 1944 was made by the aluminothermic process. Virtually all was produced from domestic ores. However, a small quantity of Canadian ore was imported into the country, converted into molybdenum products, and then exported.

Molybdic oxide, calcium molybdate, and molybdenum compounds.—As these products are used as alloying agents in the production of iron and steel, they are included with ferro-alloys. In 1944 these compounds averaged 55 percent Mo compared with 53 percent in 1943. These materials are considerably less expensive than ferromolybdenum and consequently are used to a greater extent.

Ferrotitanium.—The bulk of the ferrotitanium produced in 1944 was made in electric furnaces, but some was produced by the aluminothermic process. The ferrotitanium produced in 1944 averaged 20 percent titanium, and both foreign and domestic ores were consumed in its manufacture. Ferrotitanium is used chiefly as a deoxidizer

FOREIGN TRADE

Imports and exports of the rarer metals are not recorded separately but are grouped as shown in the following tables. Ferrosilicon comprised most of the imports in both 1943 and 1944.

Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1943-44, by varieties

Variety of alloy	1943			1944		
	Gross weight (net tons)	Content (net tons)	Value	Gross weight (net tons)	Content (net tons)	Value
Ferromanganese:						
Containing over 1 percent carbon	2,302	990	\$160,600	4,199	3,308	\$394,641
Spiegeleisen	3,254	(1)	140,247	3,761	(1)	153,032
Ferrochrome or ferrochromium:						
Containing 3 percent or more carbon ..	18	10	2,986	113	79	24,795
Containing less than 3 percent carbon ..	455	305	108,670			
Ferrosilicon:	10,546	901	156,077	22,646	4,189	750,153
Tungsten acid and other compounds of tungsten, n. s. p. f. (tungsten content)				(1)	(1)	250

¹ Not recorded.

² 21 pounds.

Ferromanganese and ferrosilicon imported for consumption in the United States, 1943-44, by countries

Country	Ferromanganese (manganese content)				Ferrosilicon (silicon content)			
	1943		1944		1943		1944	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Canada			2,232	\$296,359	901	\$156,077	4,189	\$750,153
India and Dependencies	990	\$160,600	1,076	98,282				
	990	160,600	3,308	394,641	901	156,077	4,189	750,153

Ferro-alloys and ferro-alloy metals exported from the United States, 1943-44, by varieties

Variety of alloy	1943		1944	
	Net tons	Value	Net tons	Value
Ferromanganese	12,510	\$1,717,888	600	\$101,445
Spiegeleisen	314	10,123	202	6,508
Other ferro-alloys ¹	33,787	5,513,018	7,978	9,307,248

¹ Includes ferrosilicon, ferrotungsten ferrovanadium, and other ferro-alloys.

STEEL

GENERAL FEATURES

Steel production continued at a high rate throughout 1944, furnaces operating at an average of 96 percent of capacity for the year. Capacity for producing steel increased 2,928,000 net tons to reach a new record total of 93,565,000 tons. Total production of steel in the

United States in 1943 was 89,641,600 tons, a record output. Of the total, 89.7 percent was made in open-hearth furnaces, 5.6 percent in bessemer converters, 4.7 percent in electric furnaces, and only 25 tons in crucible furnaces. In 1944, 90.6 percent of the domestic steel output was made in furnaces in the Northeastern district, 4.5 percent in the Southern district, and 4.9 percent in the Western district compared with 92.5 percent, 4.3 percent and 3.2 percent, respectively, in 1943.

The data concerning steel production used by the Bureau of Mines are furnished by the American Iron and Steel Institute. The output from steel foundries that do not produce steel ingots is not included in the statistics.

Steel capacity, production and percent of operations, 1940-44, in net tons ¹

[Ingots and steel for castings ²]

Years	Capacity	Production					Percent capacity
		Open hearth	Bessemer	Crucible	Electric and all other	Total	
1940	81,619,496	61,573,083	3,708,573	1,024	1,700,006	66,982,686	82.1
1941	85,158,150	74,389,619	5,578,071	2,313	2,869,256	82,839,259	97.3
1942	90,293,000	76,501,957	5,553,424	2,010	3,974,540	86,031,931	96.8
1943	90,636,000	78,621,804	5,625,492	146	4,589,070	88,836,512	98.0
1944	93,564,560	80,363,953	5,039,923	25	4,237,699	89,641,600	95.8

¹ American Iron and Steel Institute.

² The figures include only that portion of the capacity and production of steel for castings used by foundries which were operated by companies producing steel ingots.

³ Average annual capacity as of Jan. 1 and July 1, 1941.

⁴ Annual capacity as of Jan. 1, 1943.

⁵ Annual capacity as of Dec. 31.

Open-hearth steel ingots and castings manufactured in the United States, 1940-44, by States, in net tons

[Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots]

State	1940	1941	1942	1943	1944
New England States	322,753	462,754	472,521	487,773	444,101
New York and New Jersey	3,618,444	4,232,521	4,378,868	4,488,951	4,365,108
Pennsylvania	18,469,170	23,007,147	23,562,866	24,548,335	24,677,513
Ohio	11,769,780	14,746,523	14,769,085	14,834,574	15,011,818
Indiana	8,421,956	10,366,380	10,578,989	10,679,645	10,925,049
Illinois	4,963,457	5,998,679	6,335,946	6,350,319	6,496,338
Other States	14,007,523	15,575,615	16,403,742	17,232,217	18,444,026
	61,573,083	74,389,619	76,501,957	78,621,804	80,363,953

Bessemer-steel ingots and castings manufactured in the United States, 1940-44, by States, in net tons

[Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots]

State	1940	1941	1942	1943	1944
Ohio	1,459,807	2,265,987	2,250,717	2,365,326	2,207,176
Pennsylvania	1,366,017	1,996,779	1,997,547	1,926,316	1,645,247
Other States	882,749	1,345,305	1,305,160	1,333,850	1,187,500
	3,708,573	5,578,071	5,553,424	5,625,492	5,039,923

Steel electrically manufactured in the United States, 1940-44, in net tons

[Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots]

Year	Ingots	Castings	Total	Year	Ingots	Castings	Total
1940.....	1,608,032	91,974	1,700,006	1943.....	4,473,377	115,663	4,589,070
1941.....	2,758,611	110,645	2,869,256	1944.....	4,131,703	105,996	4,237,699
1942.....	3,843,757	130,783	3,974,540				

The steel output for 1944 includes 10,633,086 net tons of alloy-steel ingots and castings, which represents 12 percent of the total. This figure includes steels in which the minimum of the range specified in one or more of the elements named exceeds the following percentages: Copper, 0.60 percent; manganese, 1.65 percent; silicon, 0.60 percent; aluminum, chromium, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, and zirconium, any percentage. The output of alloy steels in 1944 decreased 19 percent, whereas steel increased over 1943. Of the total alloy-steel output in 1944, 61 percent came from basic open hearths, 5 percent from acid open hearths, 34 percent from electric furnaces, 23 tons from crucible furnaces, and none from Bessemer converters.

From the accompanying tables it will be seen that most of the steel made in electric furnaces (86 percent in 1944) is alloy steel. Typically, steels with higher alloy content are made in electric furnaces and steel with lower alloy content by the open-hearth process.

Alloy-steel ingots and castings manufactured in the United States, 1940-44, by processes, in net tons

[Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots]

Process	1940	1941	1942	1943	1944
Open hearth:					
Basic.....	3,421,961	5,306,415	7,524,209	8,539,523	6,494,627
Acid.....	252,965	433,240	608,867	677,416	515,662
Bessemer.....	3,990	3,890			
Crucible.....	255	933	522	136	23
Electric.....	1,286,716	2,461,651	3,392,776	3,932,743	3,622,774
	4,965,887	8,206,129	11,526,374	13,149,818	10,633,086

CONSUMPTION OF METALLIFEROUS MATERIALS

During 1944 steel furnaces used 6,228,384 net tons of ores (excluding mill scale) and sinter. Of this quantity 12,565 tons were foreign, originating in Africa, Mexico, and Sweden.

Both charge ore and feed ore are used in the basic open-hearth process. Charge ore is added to furnish oxygen to the charge before it is melted. This ore should be low in both combined and uncombined moisture, silica content, and fines. Ore containing high quantities of silica requires large additions of limestone and consequently produces large volumes of slag, which are expensive and reduce furnace efficiency.

Feed ore, which is added to the heat during the working period, should be hard, dense, coarse, and low in moisture. Although moderately high silica ore can be used as feed ore it is undesirable, as in charge ore, because of the larger quantity of slag necessitated.

Lump ore, which is preferred as feed ore, commands a high price because it is usually mined by underground methods, and the supply is limited.

Sintered pyrite ash and sintered iron ore frequently are used as charge and feed ores. However, these materials are less dense than lump ore and lower in oxygen content. Consequently, more sinter is required to accomplish the same amount of oxidation.

The following table was compiled from Bureau of Mines surveys.

Metalliferous materials consumed in steel furnaces in the United States in 1944, by districts, in net tons

District	Iron ore		Sinter	Manganese ore		Ferro-alloys	Iron and steel scrap		Pig iron
	Domestic	Foreign		Domestic	Foreign		Home	Purchased	
Northeastern	4,405,640	12,562	1,449,489	581	3,681	(1)	26,945,713	15,741,910	49,574,005
Southeastern	23,380	-----	100,405	-----	-----	(1)	1,020,368	202,161	2,770,524
Western	200,082	-----	36,760	1,596	5,640	(1)	1,456,787	2,249,568	1,760,148
	4,629,102	12,562	1,586,654	2,177	9,321	1,648,000	29,422,868	18,193,639	54,104,677

¹ Separation by districts not available.

FOREIGN TRADE

Imports and exports of iron and steel products are given in detail in the following tables.

Iron and steel imported for consumption in the United States, 1943-44, by commodities

Commodity	1943		1944	
	Net tons	Value	Net tons	Value
Semimanufactures:				
Steel bars:				
Concrete reinforcement	56	\$6,506	-----	-----
Solid or hollow, n. e. s.	2,739	409,064	300	\$51,676
Hollow and hollow drill steel	9	2,008	(1)	3
Bar iron	3	460	1	100
Wire rods, nail rods, and flat rods up to 6 inches in width	31	3,181	2	893
Boiler and other plate iron and steel, n. e. s.	397	31,933	5,652	292,611
Steel ingots, blooms, and slabs	346	46,984	14	2,886
Billets, solid or hollow	3,001	578,581	66	7,792
Die blocks or blanks; shafting, etc.	412	250,269	229	64,895
Circular saw plates	3	1,712	2	1,444
Sheets of iron or steel, common or black and boiler or other plate iron or steel	5	2,548	3	314
Sheets and plates and steel, n. s. p. f.	62	5,883	7	1,237
Tin plate, ternplate, and taggers' tin	113	27,136	125	30,106
Manufactures:				
Structural iron and steel	170	27,781	28,016	1,666,062
Rails for railways	6,307	123,556	7,838	164,669
Rail braces, bars, fish plates or splice bars, and tie plates	1,077	46,049	2,055	79,879
Pipes and tubes:				
Cast-iron pipe and fittings	25	3,426	100	2,788
Other pipes and tubes	596	126,583	583	173,486
Wire:				
Barbed	60	9,958	600	30,000
Round wire, n. e. s.	103	16,206	1	149
Telegraph, telephone, etc., except copper, covered with cotton, jute, etc.	432	149,295	154	77,271
Flat and steel strips not thicker than 3/4-inch and not over 16 inches wide	168	168,246	19	47,879
Rope and strand	348	147,353	2,973	1,279,949
Galvanized fencing wire and wire fencing	6	386	-----	670
Hoop, band or strips, or scroll iron or steel, n. s. p. f.	2	98	(1)	11
Nails	15	2,305	7	2,933
Castings and forgings, n. e. s.	1,083	667,616	7,277	1,419,093

¹ Less than 1 ton.

Iron and steel exported from the United States, 1943-44, by commodities

Commodity	1943		1944	
	Net tons	Value	Net tons	Value
Semimanufactures:				
Steel ingots, blooms, billets, slabs, and sheet bars.....	2,063,997	\$92,786,478	1,106,723	\$50,309,151
Iron and steel bars and rods:				
Iron bars.....	4,382	562,800	3,588	526,144
Concrete reinforcement bars.....	75,484	4,068,549	258,570	15,598,710
Other steel bars.....	548,896	79,641,877	389,966	56,651,682
Wire rods.....	176,040	9,201,840	123,804	6,077,566
Iron and steel plates, sheets, skelp, and strips:				
Boiler plates.....	45,063	2,928,346	24,058	1,542,639
Other plates, not fabricated.....	685,455	42,508,445	306,456	19,142,188
Skelp iron or steel.....	116,323	4,901,579	157,746	6,812,945
Iron and steel sheets, galvanized.....	72,417	5,801,469	95,123	7,305,673
Steel sheets, black, ungalvanized.....	699,818	47,832,924	780,929	58,120,557
Iron sheets, black.....	4,650	337,600	18,876	1,381,825
Strip band, and scroll iron or steel:				
Cold-rolled.....	95,468	18,976,149	85,791	12,976,801
Hot-rolled.....	104,561	9,018,004	126,164	14,035,549
Tin plate, terneplate, and taggers' tin.....	444,176	46,614,533	489,290	52,320,984
Manufactures—steel-mill products:				
Structural iron and steel:				
Water, oil, gas, and other storage tanks complete and knocked-down material.....	29,162	4,209,184	43,765	6,336,788
Structural shapes:				
Not fabricated.....	187,811	9,473,200	166,077	8,672,124
Fabricated.....	46,545	5,726,487	54,736	7,653,208
Plates, fabricated, punched, or shaped.....	24,161	2,767,806	21,134	1,826,968
Metal lath.....	531	101,953	636	103,610
Frames, sashes, and sheet piling.....	5,099	436,151	14,137	861,503
Railway-track material:				
Rails for railways.....	311,860	12,880,342	316,915	12,969,007
Rail joints, splice bars, fishplates, and tie plates.....	57,475	3,744,192	76,641	4,858,575
Switches, frogs, and crossings.....	20,828	2,835,362	36,381	4,879,947
Railroad spikes.....	13,803	1,023,960	17,020	1,224,136
Railroad bolts, nuts, washers, and nut locks.....	5,099	848,605	4,560	754,960
Tubular products:				
Boiler tubes.....	56,698	9,173,588	77,971	14,600,087
Casing and oil-line pipe.....	113,234	10,648,733	198,618	20,071,346
Seamless black pipe, other than casing and oil line.....	83,350	8,934,718	45,068	6,336,503
Welded black pipe.....	93,169	9,031,002	63,612	6,127,195
Welded galvanized pipe.....	54,008	5,438,550	68,037	6,799,632
Malleable-iron screwed pipe fittings.....	5,805	2,145,184	4,548	1,781,795
Cast-iron screwed pipe fittings.....	2,074	506,829	769	220,166
Cast-iron pressure pipe and fittings.....	18,710	1,795,464	34,085	2,152,154
Cast-iron soil pipe and fittings.....	8,529	642,404	8,090	848,268
Riveted-steel or iron pipe and fittings.....	130,965	26,960,243	113,157	26,371,360
Wire and manufactures:				
Barbed.....	22,330	1,968,599	28,306	2,585,361
Galvanized wire.....	71,868	9,130,590	69,799	8,624,175
Iron and steel wire, uncoated.....	90,925	12,287,624	71,841	9,190,420
Wire rope and strand.....	38,921	16,952,333	39,098	16,270,030
Woven-wire fencing and screen cloth.....	7,276	2,969,492	8,943	3,449,514
All other.....	35,248	10,976,584	45,750	11,630,585
Nails and bolts (except railroad):				
Wire nails.....	41,155	3,378,227	42,675	3,497,808
Horseshoe nails.....	1,188	314,468	1,566	458,214
All other nails, including tacks and staples.....	7,286	1,266,443	9,650	5,540,658
Bolts, nuts, rivets, and washers (except aircraft and railroad).....	54,507	14,318,184	56,112	14,006,918
Castings and forgings:				
Horseshoes and calks.....	155	23,288	298	46,014
Iron and steel, including car wheels, tires, and axles.....	221,064	50,655,304	174,855	37,592,149
Advanced manufactures:				
House-heating boilers and radiators.....		410,973		313,887
Oil burners and parts.....		1,454,742		1,314,572
Tools:				
Axes.....		723,832		645,190
Shovels, spades, scoops, and drainage tools.....		598,459		1,323,097
Hammers and hatchets.....		706,811		845,448
Saws, wood and metal cutting.....		6,622,237		6,678,457
All other tools.....		65,774,674		50,201,018

MANGANESE

By NORWOOD B. MELCHER¹

SUMMARY OUTLINE

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GENERAL SUMMARY

A new steel-production peak (89,641,600 short tons), supported by ample supplies of manganese ore, resulted in a continued record activity in the manganese industry during 1944. Although imports of manganese ore decreased 19 percent from 1943, the total supply (imports plus domestic mine shipments) totaled 1,405,177 tons and was only 12 percent lower than consumption. Stocks of ore containing 35 percent or more manganese at the close of 1944 were sufficient to last 13 months at the 1944 average monthly consumption rate.

Production of domestic manganese ore containing (natural) 35 percent or more manganese in 1944 was the largest since 1918 and was the second most productive year on record. Output as measured by shipments from mines totaled 247,616 short tons in 1944 compared with 205,173 tons in 1943 and 190,748 tons in 1942. Shipments of ferruginous manganese ore (10 to 35 percent manganese) amounted to 297,136 tons, and shipments of manganiferous iron ore (5 to 10 percent manganese) were 1,190,476 tons compared with 471,593 tons and 1,251,275 tons, respectively, in 1943. The value of manganese ore shipments in 1944 totaled \$9,014,875 (\$36.41 per short ton) compared with \$7,278,758 (\$35.48 per ton) in 1943.

During 1944 various Government agencies in cooperation with industry were active in planning a stock-piling program for strategic minerals and metals, including manganese. Details of the present status of stock-piling legislation are presented in the chapter of this volume on the Review of the Mineral Industries in 1944.

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Salient statistics of the manganese industry in the United States, 1925-29 (average) and 1940-44, in short tons.

	1925-29 (average)	1940	1941	1942	1943	1944
Manganese ore:						
Total shipments containing 35 percent or more Mn.....	66,429	44,936	87,794	190,748	205,173	247,616
Shipments of metallurgical ore.....	146,919	30,416	73,852	177,966	195,096	241,170
Shipments of battery ore.....	19,510	10,383	11,399	12,377	9,973	6,224
Imports for consumption.....	672,000	1,435,928	1,714,581	1,583,024	1,511,630	1,315,508
Ferro-alloys:						
Production of ferromanganese.....	343,123	514,682	580,704	661,338	702,484	702,632
Imports of ferro manganese ¹	456,661	9,601	5,696	11,635	990	3,308
Production of spiegeleisen.....	106,919	114,119	177,915	186,026	149,036	165,530
Imports of spiegeleisen ²	8,174	17,455	4,741	1,990	3,254	3,761
Exports of spiegeleisen and ferromanganese.....	4,221	14,600	5,155	7,223	12,824	802

¹ Includes small quantity of miscellaneous ore.

² Imports for consumption.

³ Manganese content.

⁴ Includes small quantity of other manganese alloys.

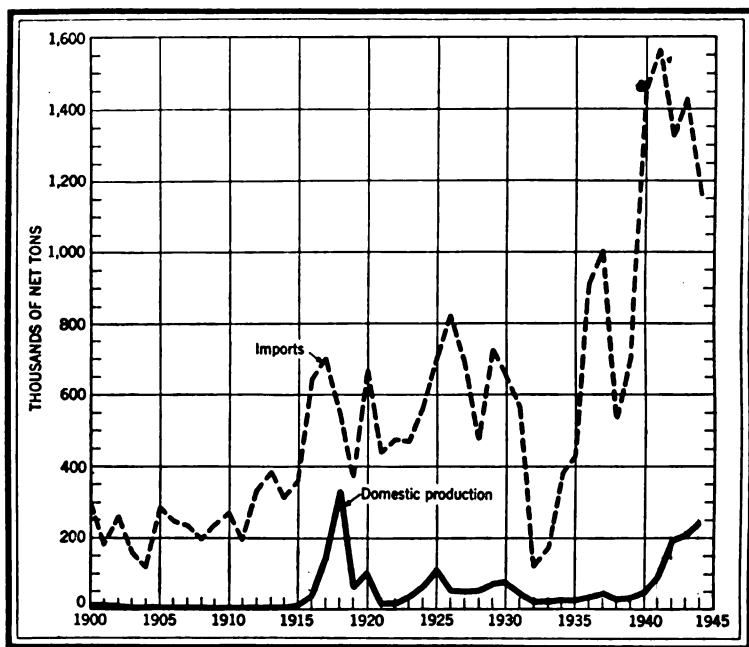


FIGURE 1.—Imports and domestic production (mine shipments) of manganese ore, 1900-1944. Statistics on imports shown in the graph represent general imports for 1900-1933, imports for consumption adjusted for changes in bonded warehouse stocks for 1934-39, and general imports for 1941-44.

Government purchases continued at a high rate during 1944. On September 1, 1944, the Metals Reserve Company issued new regulations to affect all contract and small-lot purchases of domestic manganese ore made after December 31, 1944. The specifications were relatively severe and forced the closing of the shippers that depended on the Government to purchase their product. Although the new schedule is more severe with regard to specifications, the prices for certain grades of ore are considerably higher than previously. For example, the base price for 42-percent ore under the new schedule is

\$39.06 per long dry ton compared with \$27.30 under the terms of the previous schedule effective since May 4, 1942. However, the rate for 48-percent ore is unchanged at \$1 per unit or \$48 per ton. The price regulations affecting purchases of small lots of manganese ore are identical to the contract specifications except that concentrates are acceptable only on a negotiated basis.

A brief comparison in the prices (disregarding penalties) under the old and new schedules follows. Penalties that are more severe than before will lessen to some extent the advantage of a higher basic rate.

Metals Reserve Company prices for domestic manganese ore under 1945 schedule compared with schedule effective from 1942 to 1945

Grade (percent Mn dry)	Price per long dry ton		Grade (percent Mn dry)	Price per long dry ton	
	Old	New		Old	New
54-----	\$54.00	\$55.62	46-----	\$36.80	\$45.08
52-----	52.00	53.04	44-----	35.20	42.24
50-----	50.00	50.50	42-----	27.30	39.06
48-----	48.00	48.00			

Price regulation.—Ceiling prices for manganese ore remained unchanged at 90 cents per long-ton unit at New York, Philadelphia, Baltimore, Norfolk; 85 cents at Mobile and New Orleans; 96 cents at Fontana, Calif.; Provo, Utah; and Pueblo, Colo.

Regulation 248 prescribes maximum prices for metallurgical manganese ores. Amendment 4 to the regulation was issued April 10, 1944, exempting deliveries of manganese ore in quantities not exceeding 500 pounds. The amendment was issued to cover small quantities of ore shipped for experimental purposes by educational and private laboratories and industries.

New operations.—Domestic production of manganese ore was bolstered by three new operations that contributed 46,183 short tons of concentrates and nodules during 1944. A brief discussion of these operations follows:

The leaching and nodulizing plant of the Manganese Ore Co., Las Vegas, Nev., closed down on September 30, 1944, after producing 13,963 tons of nodules since operations were begun in October 1943. Slightly over 500 men were released at the close of operations, and a very few stayed on to study the process further. This plant, which was designed to produce 100,000 tons of nodules annually, failed to reach anything near capacity operation. The operation was marked by a series of mechanical failures and problems, many of which might have been obviated through experimentation with a pilot plant of relatively small capacity. The company officials believe that the process was technically sound but that the facilities did not prove to be suited to the operation.

The Defense Plant Corporation custom concentrator at Butte, Mont., began operations during January 1944, with the Domestic Manganese & Development Co. as agent for Metals Reserve Company. Manganese oxide and carbonate ores from Philipsburg were treated. However, it was discovered that flotation was more satisfactory using carbonate ores alone, and the use of oxides was discontinued. During the course of the year this mill produced (dry)

19,277 net tons of nodules averaging 51.02 percent Mn, 3.4 percent Fe, 12.02 percent SiO_2 , and 0.48 percent P.

The largest shipment of manganese concentrates in the United States during 1944 came from the Old Dominion mine in Augusta County, Va., operated by the Dominion Manganese Corp., New York City. Shipments from this mine during 1944 totaled 12,943 short tons of psilomelane ore averaging (natural) 41.93 percent Mn, 3.83 percent Fe, 10.82 percent SiO_2 , 0.159 percent P, and 4.17 percent moisture. The ore is mined by open-pit methods and concentrated by log washing, hand sorting, and jigging.

POSTWAR OUTLOOK

Victory in Europe followed by an inevitable easing of Atlantic shipping will secure the position of the United States with regard to manganese ore. Supplies from the Soviet Union, which were completely cut off during the European war, are expected again to enter the trade, and shipments from Brazil, Gold Coast, and Union of South Africa will experience the advantages of peaceful seas. A slackening of steel production beginning in 1945 will improve the Nation's manganese supply-demand relationship further.

Requirements for manganese ore probably will drop gradually from the 1943-44 level of 1,600,000 short tons per year to about 1,000,000 tons after V-J Day. This, however, does not necessarily foreshadow an immediate cutback in domestic production to prewar levels. Some important operations started during the war are expected to continue. The degree to which this is true will depend upon future trade policies and the extent to which operators of relatively high cost milling installations will have been able to reduce their investment cost. A 1,000,000-ton consumption rate is about 50 percent higher than the prewar (1935-39) average and should offer a broader market for any domestic ore that can compete on a specification and price basis.

Work has continued during the war with an aim to make the United States self-supporting in manganese by developing new methods of concentrating such low-grade materials as the manganese-bearing shales at Chamberlain, S. Dak. Research has indicated that the Nation could procure adequate supplies of high-grade material from this source at a relatively high cost, but a competitive product is not in prospect for the next pentad.

Increased use of electrolytic manganese in the ferrous field and the discovery of new uses, accelerated during the war, are expected to continue. Marked increases in the demand for this material during the closing months of 1944 taxed the ability of producers to supply sufficient metal; a new producer of electrolytic manganese, the Olympic Mines, Inc., Hoodspoor, Wash., entered the field in 1944, and interest has been indicated by others. Production costs of electrolytic manganese should decline as demand and output increase.

DOMESTIC PRODUCTION

The following table shows the various types of manganiferous materials shipped by domestic producers from 1940 to 1944:

Manganiferous raw materials shipped by producers in the United States, 1940-44, in short tons

Year	Metallurgical ore				Battery ore	Miscellaneous
	Manganese ore (35 percent or more Mn)	Ferruginous manganese ore (10 to 35 percent Mn)	Manganiferous iron ore (5 to 10 percent Mn)	Manganiferous zinc residuum		
1940	30,416	358,406	914,526	172,990	10,383	4,137
1941	73,852	512,162	918,725	282,049	11,309	2,543
1942	177,966	265,663	1,500,613	292,051	15,410	473
1943	195,096	468,862	1,251,275	270,328	12,704	104
1944	241,170	296,981	1,190,476	247,402	6,224	377

Shipments of various grades of manganese-bearing ores during the last 5 years are given, by States, in the following tables. In addition, battery-grade ore was produced from Montana; a small quantity of miscellaneous ore came from South Carolina and Virginia; and manganiferous zinc residuum was produced from New Jersey zinc ores.

Metallurgical manganese ore shipped from mines in the United States, 1940-44, by States, in short tons

State	1940	1941	1942	1943	1944	State	1940	1941	1942	1943	1944
Ala.	64	26	49			Oreg.		85	45	143	
Ariz.	348	2,946	5,779	8,519		Pa.			22		
Ark.	6,808	5,015	4,132	5,319	7,109	S. C.				312	1,400
Calif.	177	2,600	10,112	20,604	21,540	S. Dak.			81	12	
Colo.	251	190	513	707		Tenn.	7,821	4,394	2,247	2,501	418
Ga.	4,001	4,893	4,890	2,467	1,135	Utah		30	43	970	91
Idaho		34	36			Va.	1,168	4,983	11,024	7,040	20,034
Mo.		12	239	180		Wash.		1,588	10,660	7,731	5,199
Mont.	9,218	43,555	120,409	130,789	153,665	W. Va.	245	2,458	2,240		
Nev.	235	2,937	6,112	10,451	21,799	Wyo.				60	
N. Mex.	50		1,267	469	273						
N. C.		35		140							
Okla.		40	31	265			30,416	73,852	177,966	195,096	241,170

Ferruginous manganese ore shipped from mines in the United States, 1940-44, by States, in short tons

State	1940	1941	1942	1943	1944	State	1940	1941	1942	1943	1944
Ala.	383		206			N. Mex.	41,255	65,483	89,009	72,967	100,683
Ariz.		17		498	320	N. C.	213	174		115	
Ark.	1,204	3,381	14,067	8,207	14,755	S. C.				155	171
Calif.	97	464	4,659	8,492	4,598	Okla.		56			
Colo.	3,669		44			Tenn.	2,606	1,865	916	803	6,779
Ga.	11,298	6,715	10,514	5,835	2,232	Tex.			142		
Idaho	351	390				Utah	2,354	551	78	18	32,141
Mass.	2,128	4,480	3,301			Va.	5,020	4,375	3,905	12,208	4,419
Mich.			34,643	100,092		Wash.		7			
Minn.	278,580	409,855	88,509	253,779	122,765	W. Va.		448	560		
Mont.	4,051	4,988	15,468	2,041	781						
Nev.	5,167	8,913	2,743	6,383	7,402		358,406	512,162	268,764	471,593	297,136

Manganiferous iron ore shipped from mines in the United States, 1940-44, by States, in short tons

State	1940	1941	1942	1943	1944
Alabama			162		
Georgia	230	1,192			
Michigan	20,851				45,689
Minnesota	893,359	917,533	1,500,451	1,251,275	1,144,787
Virginia	86				
	914,526	918,725	1,500,613	1,251,275	1,190,476

Manganese and manganiferous ores shipped from mines in the United States in 1944, by States

	Metallurgical			Battery			Miscellaneous			Total		
	Shippers	Short tons		Shippers	Short tons		Shippers	Short tons		Shippers	Short tons	
		Gross weight	Manganese content		Gross weight	Manganese content		Gross weight	Manganese content		Gross weight	Manganese content
Manganese ore: ¹												
Alabama.....	1	49	22							1	49	22
Arizona.....	23	8,519	3,180							23	8,519	3,180
Arkansas.....	17	7,109	2,868							17	7,109	2,868
California.....	56	21,540	8,764							56	21,540	8,764
Georgia.....	1	1,135	412							1	1,135	412
Montana.....	10	153,965	90,742							11	156,889	93,367
Nevada.....	7	21,799	11,206	2	6,224	2,625				7	21,799	11,206
New Mexico.....	3	273	101							3	273	101
South Carolina.....	1	1,400	524							1	1,484	555
Tennessee.....	3	418	162							3	418	162
Utah.....	1	30	10							1	30	10
Virginia.....	7	20,034	8,169							8	20,172	8,238
Washington.....	1	5,199	2,089							1	5,199	2,089
Total.....	131	241,170	128,849	2	6,224	2,625	5	222	100	133	247,616	131,574
Ferruginous manganese ore: ¹												
Arizona.....	3	320	109							3	320	109
Arkansas.....	13	14,755	3,357							13	14,755	3,357
California.....	16	4,598	1,133							16	4,598	1,133
Georgia.....	4	2,232	579							4	2,232	579
Minnesota.....	1	122,765	17,157							1	122,765	17,157
Montana.....	3	781	277							3	781	277
Nevada.....	2	1,931	1,931							2	7,492	1,931
New Mexico.....	1	100,683	12,777							1	100,683	12,777
South Carolina.....	1	171	41							1	171	41
Tennessee.....	2	6,779	1,205							2	6,779	1,205
Utah.....	2	32,141	7,194							2	32,141	7,194
Virginia.....	4	4,204	709							5	4,419	743
Total.....	52	206,981	46,469				1	155	34	53	207,136	46,503
Manganiferous iron ore: ¹												
Michigan.....	1	45,689	3,939							1	45,689	3,939
Minnesota.....	4	1,144,787	86,837							4	1,144,787	86,837
Total.....	5	1,190,476	90,776							5	1,190,476	90,776

¹ Containing 35 percent or more manganese (natural).² Value included in total.³ Shipper in Montana shipped both battery and metallurgical ore.⁴ Shipper in South Carolina shipped both miscellaneous and metallurgical ore.¹ Shippers in Virginia shipped both miscellaneous and metallurgical ore.² Containing 10 to 35 percent manganese (natural).³ Excludes concentrating-grade ore shipped to Government stock piles.⁴ Containing 5 to 10 percent manganese (natural).

The following historical table presents a complete production record for the important producing States. As the Bureau of Mines has presented the data for the Manganese chapter in short tons (2,000 pounds) since 1942 and in long tons before 1942, the following table is given in short tons to place all years on a comparable basis.

Manganese ore (85 percent or more Mn) produced and shipped in the United States, 1898-1944, by States, in short tons

Year	Alabama	Arizona	Arkansas	California	Colorado	Georgia	Idaho	Montana	Nevada	New Mexico	Tennessee	Utah	Virginia	Washington	Other States ¹	Total
1898-79			469	6,160		22,344							20,160			49,123
1880						2,016							4,100		336	6,452
1881			112			1,344							3,690		336	5,482
1882			186			1,120							3,340		420	5,076
1883			448										5,968		448	6,894
1884			896										10,058		448	11,402
1885			1,661	224		2,890		224					20,964		56	20,049
1886			3,714	112		6,765		34					22,035		16	33,816
1887	84		6,329			10,107					56		22,215		16	38,667
1888			4,829			6,236							19,764		16	32,702
1889			2,831	59		5,833					34		16,370		1,957	27,101
1890			5,980	432		5,839		17					14,223		16	21,602
1891			1,848	790		4,004		112					18,197		307	25,146
1892			7,513			811							6,808			15,246
1893			2,262	448		1,430					640		4,583			8,644
1894			2,166	311		1,330					1,033		2,013			7,065
1895			3,350	588		4,319							1,921		515	10,693
1896			3,832	318		4,575							2,260		314	11,299
1897			3,629	542		3,732							4,088		438	12,441
1898			2,981	606		3,492					12		6,341			17,872
1899	25		399	129		3,460					427		8,827			11,127
1900			162	147		3,861					21		8,758			13,184
1901	19		102	683		3,563		153			34		4,788			13,434
1902			92	948		3,920					448		3,406			8,375
1903				18		560							2,017			9
1904				67		168							3,420			3,523
1905				1							22		6,751			4,612
1906			69	112							34		5,156			7,751
1907											112		6,881		896	6,276
1908													1,729			1,729
1909													1,969			2,529
1910			560										2,750			2,750
1911				2									1,721			1,721
1912				21									4,534			4,534
1913													1,831			1,831
1914	224		1,443	561		3,548					168		1,814			2,951
1915	30		7,076	2,870	168	1,761					480		1,814			10,705
1916				6,872	123			7,188	346	567		34	1,436	101	896	35,280

Manganese ore (95 percent or more Mn) produced and shipped in the United States, 1838-1944, by States, in short tons—Continued

Year	Alabama	Arizona	Arkansas	California	Colorado	Georgia	Idaho	Montana	Nevada	New Mexico	Tennessee	Utah	Virginia	Washington	Other States ¹	Total
1917	206	16,878	11,357	15,900	67	4,048		68,442	3,864	2,915	2,236	4,698	13,843		820	144,873
1918	794	19,725	8,659	26,955	5,490	7,480		223,923	22,257	3,501	4,601	5,712	12,739		1,266	342,515
1919	45	19,702	2,805	12,644	12,506	54		27,902	27,902	308	308		2,309			41,552
1920	64	2,600	3,828	1,941	4,080	382		85,614	1,389	2,299	592		2,895		45	103,750
1921		367	3,815		4,549			12,965			156		2,803			13,155
1922		227	2,536					10,921	20		177		803			33,013
1923	27	274	4,220	398	2,551	1,682		24,546		200	270		1,105		38	33,290
1924		47	3,808	952	5,970	1,224		26,698	1,467	868	510		1,753	5,600		63,297
1925	1,051	320	3,939	973	5,832	1,847		85,331	1,952	1,779	304	56	2,468	9,087	58	110,174
1926	1,004	3,006	2,744			3,641	930	26,557	1,800	2,202	1,712		2,267	3,541	62	51,910
1927	769	4,374	2,918		94	3,548	3,563	29,687	1,520	2,453	553	30	3,586			60,410
1928	472	3,028	4,038			5,294	1,506	27,001	2,932	2,932	682		3,260		11	52,433
1929			4,825	637		2,824	1,485	47,006	2,906	3,317	580	99	3,317		47	67,625
1930		2,974	3,659	181		21,155		39,878	1,668	2,883	539		4,315		344	73,080
1931		408	4,511			7,270		28,909	1,201		78		1,683		236	43,351
1932		45	1,463			7,224		17,330					388			21,910
1933	290		2,117			1,753		10,438			650		5,708		106	21,444
1934	963		6,543			7,035		12,934			1,210		7,769			29,697
1935			4,266	177		7,705		12,934			2,120		7,746			29,389
1936	641		5,104	343		7,285		18,431			3,004	1,831	7,534		199	33,974
1937	324		4,403			4,772		26,953		953			2,337			33,071
1938	296		3,345			3,425		13,368	48	953	4,025	36	2,311		183	28,360
1939	260		6,000	7		2,004		12,473		628	8,773	56	2,860	11		27,777
1940	272	413	6,808	177	251	2,004		21,463	235	350	8,308	31	2,482			32,824
1941	185	1,012	5,015	4,096	190	4,976	34	54,565	2,937	50	8,425	33	6,091	1,588	245	84,938
1942	26	2,946	4,132	12,968	513	4,917		130,890	6,122	1,267	2,437	970	11,246	10,960	2,658	167,795
1943		5,779	5,319	23,298	707	2,489	36	138,115	10,451	719	2,603	91	7,040	7,731	1,112	203,173
1944	49	8,519	7,109	21,540		1,135		159,889	21,799	273	418	30	20,172	5,199	1,484	247,016
Total	8,636	78,040	191,354	148,591	34,010	211,848	7,554	1,419,924	77,339	31,185	59,640	19,426	413,139	43,518	22,033	2,767,237

¹ Massachusetts, Michigan, Minnesota, Missouri, New Jersey, North Carolina, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Vermont, West Virginia, and Wyoming.

MINING BY STATES

Alabama.—The shipment of manganese ore averaging (dry) 46.51 percent Mn from Alabama in 1944 came from the Cobalt Hill mine in Cherokee County.

Arizona.—The output of manganese ore from Arizona increased 47 percent over 1943. The Black Warrior mine, Mohave County (Artillery Peak district), shipping 1,672 short tons, was the largest operation. The American mine in Gila County was second with 1,384 tons. Counties supplying manganese ore in 1944 were Cochise, Coconino, Gila, Mohave, Navajo, Pima, Santa Cruz, Yuma, and Yavapai. Three mines in Gila County supplied the ferruginous manganese ore.

Arkansas.—The Arkansas Manganese Co. and the Walter H. Denison Manganese & Contracting Co., both of Batesville, continued to be the predominant manganese-ore shippers in Arkansas during 1944. Except for a very small shipment of ore from Polk County, all the output of manganese ore and ferruginous manganese ore came from Independence County. Included in the shipments of ferruginous ore are 5,218 short tons of stock-pile ore which was accumulated by the Metals Reserve Company for concentrating, but which was shipped in 1944 to blast furnaces in the Birmingham district. It was impossible to assign this tonnage to individual mines.

California.—The Buckeye mine in Stanislaus County continued to be the largest producer in the State in 1944. Shipments from this mine totaled 3,997 short tons averaging (dry) 37.50 percent Mn. Mines in 19 counties furnished the State total in 1943 and 1944.

Shipments of manganese ore were made by 56 concerns in 1944 compared with 50 in 1943. However, at the close of the year production virtually ceased in the State as a result of the new Metals Reserve Company specifications. Unless the grade of ore shipped from California can be improved to meet these specifications, operators will be dependent upon a small local market.

Georgia.—Neel & Neel shipped the total quantity of manganese ore from Georgia and 56 percent of the ferruginous ore from the Aubrey mine, Bartow County, in 1944. Relatively small quantities of ferruginous ore were shipped from the New Riverside, Beardon, and White mines in Bartow County. The high-grade ore was sold to Metals Reserve Company, and the low-grade was shipped to consumers in the Birmingham district.

Michigan.—Pickands, Mather & Co. shipped manganiferous iron ore from the Bengal mine, Iron County, Menominee range. The ore averaged (natural) 8.60 percent Mn, 40.69 percent Fe, 5.64 percent SiO_2 , 0.364 percent P, and 7.39 percent moisture.

Minnesota.—Ferruginous manganese ore averaging (natural) 13.976 percent Mn was shipped from the Louise and Merritt mines in Crow Wing County. Manganiferous iron ore was shipped from 4 mines on the Cuyuna range and 2 on the Mesabi during the year.

Montana.—Manganese ore in Montana comes from the Philipsburg district in Granite County and the Butte district in Silver Bow County. Since 1941, when operations were begun, the nodulizing works of the Anaconda Copper Mining Co. has been the Nation's leading producer of high-grade manganese-bearing raw material. During 1944 this operation produced 53 percent of the total United States output of manganese ore. The nodules averaged (natural) 60.61 percent Mn,

3.00 percent Fe, 8.19 percent SiO_2 , 0.063 percent P, and 0.015 percent moisture. The second largest producer in the United States was the nodulizing works of the Domestic Manganese & Development Co. at Butte. This operation is discussed earlier in this chapter under New Operations.

A small shipment of ferruginous ore was made from the Mohawk mine in Madison County. Other shipments were made from the Climax Lease mine and the Sharktown mine in Granite County.

Nevada.—Production of manganese ore from Nevada operations in 1944 was more than double the 1943 total. Sixty-four percent of the output came from the leaching and nodulizing plant of the Manganese Ore Co. in Clark County. The ore for this operation was obtained from the Three Kids mine and averaged (natural) 18.66 percent Mn in 1944. The remainder of the manganese-ore production came largely from the Manganese Mining Co. mine in White Pine County, the Black Rock mine in Lander County, and the Black Diablo mine in Pershing County. Small shipments were made from the Big Jim claim in Churchill County and the Sunny Day and Valley View mines in Humboldt County.

New Mexico.—The production of manganese ore from New Mexico in 1944 came from the Birchfield, National Defense, and Rock House mines in Sierra County. The ferruginous manganese ore was produced from the Boston Hill mine in Grant County.

South Carolina.—Abernathy & Kehaya shipped metallurgical ore containing (dry) 39.40 percent Mn and chemical ore containing (dry) 37.5 percent Mn from the Boykin Kelly & Dorn mines in McCormick County. H. M. Clegg shipped ferruginous ore from the Greenwood mine in Greenwood County.

Tennessee.—The Glenn Street mine in Unicoi County supplied virtually all of the manganese ore from Tennessee during 1944. Very small shipments were made from the Blackburn and Kemp Shoun mines in Johnson County. Of the ferruginous ore, 2,858 short tons came from the Embree mine in Washington County, and the balance was shipped from the Metals Reserve Company stock pile at Elizabethton.

Utah.—A small shipment of manganese ore was made from the Oxen 1 & 2 mines in Utah County. The Black Boy mine in Juab County (12,877 tons) and the Metals Reserve Company shipping from the stock pile at Joy supplied the ferruginous manganese ore in 1944.

Virginia.—The number of Virginia shippers declined from 17 in 1943 to 8 in 1944. The Dominion Manganese Corp., a new shipper, supplied 64 percent of the State total from the old Dominion mine in Augusta County. Other important producers were the Glade Mountain mine in Smyth County (4,885 short tons) and the Virginia Hardwood Lumber Co. mine in Bland County. Small operations in Bland, Campbell, and Smyth Counties contributed toward the total.

Washington.—The total production from Washington was hausmannite ore averaging (dry) 51.79 percent Mn, 1.72 percent Fe, 9.50 percent SiO_2 , and 0.05 percent P, from the Crescent mine in Clallam County.

IMPORTS OF MANGANESE ORE

Satisfactory data covering imports of battery-grade ore are not available for 1944. However, it is believed that all battery ore during

the year came from Gold Coast. Imports classified as battery ore from that country during 1944 totaled 54,941 short tons containing 31,153 tons of manganese.

Imports of ferruginous manganese ore (all from Mexico) amounted to only 38 short tons containing 12 tons of manganese. Imports for consumption of this material (all from Mexico) totaled 160 tons containing 42 tons of manganese and were valued at \$3,207.

The following table gives imports of all grades of manganese ore during 1944.

Manganese ore (35 percent or more Mn) imported into the United States, 1943-44 by countries

Country	General imports ¹				Imports for consumption ²					
	Short tons				Short tons				Value	
	Gross weight		Mn content		Gross weight		Mn content			
	1943	1944	1943	1944	1943	1944	1943	1944	1943	1944
Algeria.....	10,440	-----	5,376	-----	10,440	-----	5,376	-----	\$117,895	-----
Australia.....	-----	-----	-----	-----	(³)	-----	(³)	-----	-----	\$5
Belgian Congo.....	11,109	9,053	5,606	4,526	17,881	14,940	9,074	7,544	410,338	343,423
Brazil.....	317,386	170,025	135,496	71,873	373,396	197,399	168,234	89,899	5,064,803	2,654,089
Canada.....	10,649	4,289	5,230	2,101	16,335	6,009	7,894	2,885	291,364	123,723
Cuba.....	211,780	467,059	101,789	223,392	211,780	467,059	101,788	223,392	5,409,242	13,331,608
French Equatorial Africa.....	2	-----	1	-----	2	-----	1	-----	43	-----
French Morocco.....	6,900	1,348	3,495	786	6,900	1,348	3,495	786	256,105	44,127
French Oceania.....	2	-----	1	-----	2	-----	1	-----	91	-----
Gold Coast.....	128,069	170,655	65,573	88,844	216,973	159,982	112,789	82,408	3,715,210	1,812,857
India and Depend- encies.....	575,839	222,962	289,072	111,120	462,941	346,824	231,596	172,385	5,134,881	4,230,934
Mexico.....	64,901	82,960	28,348	36,489	60,462	80,035	26,662	35,466	1,137,407	1,614,870
New Zealand.....	-----	532	-----	282	-----	532	-----	282	-----	13,776
Portuguese Guinea and Angola.....	-----	-----	-----	-----	2,305	-----	1,242	-----	62,260	-----
Union of South Africa.....	92,522	28,656	42,353	13,153	127,660	41,358	58,812	19,028	1,694,196	540,784
U. S. S. R.....	-----	-----	-----	-----	4,553	-----	2,341	-----	73,060	-----
United Kingdom ⁴	-----	22	-----	20	-----	22	-----	20	-----	5,140
	1,429,599	1,157,561	682,340	552,586	1,511,630	1,315,508	729,305	633,095	23,366,895	24,716,336

¹ Comprises ore received in the United States during year; part went into consumption, and remainder entered bonded warehouses.

² Comprises receipts during year for consumption and ore withdrawn from bonded warehouses during year (irrespective of time of importation).

³ Less than 1 ton.

⁴ United Kingdom of Great Britain and Northern Ireland.

CONSUMPTION AND STOCKS OF MANGANIFEROUS RAW MATERIALS

The consumption of manganese ore in 1944 increased less than 5,000 tons over the total of 1,588,323 tons consumed in 1943. Of the 1944 total, 90 percent was of foreign origin, compared with 86 percent in 1943. Industrial stocks of manganese ore on December 31, 1944, were 42 percent less than the 854,632 tons on hand at the end of 1943.

The following table shows actual tons of manganese ore (containing 35 percent or more manganese, natural) and alloys consumed during 1944 and in stock at the end of the year.

*Consumption and stocks of manganese ore and manganese alloys in the United States
in 1944, gross weight in short tons*

	Consumed	In stock Dec. 31, 1944 ¹	
		At plant (in- cluding bonded warehouses)	In bonded warehouses
Manufacturers of manganese alloys:			
Manganese ore:			
Domestic:			
35 to 47 percent Mn (natural).....	14,909	956	-----
Over 47 percent Mn (natural).....	127,882	12,848	-----
Foreign.....	1,348,691	416,907	140,903
Total manganese ore.....	1,491,482	430,711	140,903
Ferromanganese:			
High-carbon.....	-----	35,719	14,997
Medium-carbon.....	-----		
Low-carbon.....	-----		
Total.....	-----	35,719	14,997
Spiegeleisen.....	-----	22,072	-----
Silicomanganese.....	-----	(?)	(?)
Manganese briquets.....	-----	(?)	(?)
Manufacturers of steel ingots:			
Manganese ore:			
Domestic:			
35 to 47 percent Mn (natural).....	1,445	466	-----
Over 47 percent Mn (natural).....	151	46	-----
Foreign.....	7,965	1,595	-----
Total manganese ore.....	9,561	2,107	-----
Ferromanganese:			
High-carbon.....	647,716	74,866	-----
Medium-carbon.....	10,134	1,572	-----
Low-carbon.....	10,625	1,196	-----
Total ferromanganese.....	668,475	77,634	-----
Spiegeleisen.....	134,363	37,097	-----
Silicomanganese.....	57,079	5,671	-----
Manufacturers of steel castings:			
Manganese ore:			
Domestic:			
35 to 47 percent Mn (natural).....	459	520	-----
Over 47 percent Mn (natural).....	122	-----	-----
Foreign.....	1,350	526	-----
Total manganese ore.....	1,937	1,046	-----
Ferromanganese:			
High-carbon.....	41,822	6,933	-----
Medium-carbon.....	1,428	396	-----
Low-carbon.....	705	161	-----
Total ferromanganese.....	43,955	7,490	-----
Spiegeleisen.....	13,885	2,015	-----
Silicomanganese.....	10,148	1,721	-----
Manufacturers of pig iron:			
Manganese ore:			
Domestic:			
35 to 47 percent Mn (natural).....	222	1,304	-----
Over 47 percent Mn (natural).....	-----	80	-----
Foreign.....	16,673	25,557	-----
Total.....	16,895	26,941	-----
Manufacturers of miscellaneous products:			
Ferromanganese:			
High-carbon.....	14,455	-----	-----
Medium-carbon.....	2,279	4,356	-----
Low-carbon.....	1,327	-----	-----
Total ferromanganese.....	18,061	4,356	-----
Spiegeleisen.....	12,249	4,607	-----
Silicomanganese.....	1,074	3,005	1,501
Manganese briquets.....	4,328	2,312	-----

Consumption and stocks of manganese ore and manganese alloys in the United States in 1944, gross weight in short tons—Continued

	Consumed	In stock Dec. 31, 1944 ¹	
		At plant (including bonded warehouses)	In bonded warehouses
Manufacturers of dry cells:			
Manganese ore:			
Domestic:			
35 to 47 percent Mn (natural).....	2,981	157	-----
Over 47 percent Mn (natural).....	6,235	997	-----
Foreign.....	40,633	24,811	14,349
Total manganese ore.....	49,849	25,965	14,349
Manufacturers of chemicals:			
Manganese ore:			
Domestic:			
35 to 47 percent Mn (natural).....	80	224	-----
Over 47 percent Mn (natural).....	400	554	-----
Foreign.....	22,894	7,320	-----
Total manganese ore.....	23,374	8,102	-----
Grand total:			
Manganese ore:			
Domestic:			
35 to 47 percent Mn (natural).....	20,096	3,627	-----
Over 47 percent Mn (natural).....	134,790	14,529	-----
Foreign.....	1,438,212	476,716	155,252
Total manganese ore.....	² 1,593,098	494,872	155,252
Ferromanganese:			
High-carbon.....	703,993	117,881	12,939
Medium-carbon.....	13,841	3,313	329
Low-carbon.....	12,657	4,005	1,729
Total ferromanganese.....	730,491	125,199	14,997
Spiegeleisen.....	160,497	65,790	-----
Silicomanganese.....	68,301	10,397	1,501
Manganese briquets.....	4,528	2,312	-----

¹ Excluding Government stocks.

² Included under manufacture of miscellaneous products.

³ The greater part of the consumption of ore was used in the manufacture of ferromanganese and silicomanganese. Combining consumption of ore with that of ferromanganese and silicomanganese would result in duplication.

The following table shows ores available for consumption in the United States in 1944 but without adjustments for changes in consumer or Government stocks.

Indicated consumption of manganiferous raw materials in the United States, in 1944

	Ore containing 35 percent or more Mn		Ore and residuum containing 10 to 35 percent Mn		Ore containing 5 to 10 percent Mn	
	Short tons	Mn content (percent)	Short tons	Mn content (percent)	Short tons	Mn content (percent)
Domestic shipments.....	247,616	53.1	297,136	15.7	1,190,476	7.6
Imports for consumption.....	1,315,508	48.1	160	26.1	(¹)	(¹)
Total available for consumption..	1,563,124	48.9	297,296	15.7	1,190,476	7.6

¹ Estimated none was consumed.

METALLURGICAL INDUSTRY

The steel industry in 1944, as in 1943, used an average of 13.3 pounds of manganese per short ton of steel produced. Of the 1944 consumption, 11.7 pounds were in the form of ferromanganese, 0.6 pound as spiegeleisen, 0.9 pound as silicomanganese, and 0.1 pound as manganese ore used directly. In 1943 the consumption of manganese contained in ferromanganese, spiegeleisen, and silicomanganese, and manganese ore amounted to 11.7 pounds, 0.7 pound, 0.6 pound, and 0.3 pound, respectively, per ton of steel.

The above data apply to the consumption of manganese ore in the manufacture of steel ingots and that part of steel castings manufactured by concerns that also produce steel ingots.

Open-hearth operations are the greatest users of manganese in the United States. Manganese is added to the open-hearth melt essentially as an alloying agent, a deoxidizer, and a desulfurizer. As an alloying agent, manganese has no marked effect on tensile strength of steel when below 0.3 or 0.4 percent because other substances, especially iron oxide, mask the effect. Consequently, if the beneficial effects of manganese upon tensile strength are desired, it is important to maintain as much manganese as possible in the bath, as the amount to be added during recarburizing is reduced in direct proportion to the weight of the residual manganese.

Manganese is added to the bath near the end of the heat in the form of a recarburizer. Some years ago the principal purpose of this addition was to raise the carbon content to a desired level. However, at present its most important purpose is to rid the bath of as much oxygen as possible. The recarburizer contains manganese, silicon, and carbon. It often consists of ferromanganese and ferrosilicon but has been replaced to some extent by silicomanganese, which is considered superior under certain conditions because the oxides formed from this alloy coalesce and separate more easily from the steel, eliminating the so-called oxidized inclusions before the steel freezes. Unless manganese and silicon are added in quantities above that necessary theoretically to satisfy the oxidizing reactions, the effect will be incomplete. Consequently, the recarburizer is so calculated that about 0.50 percent manganese and 0.10 percent silicon are left in the open-hearth steel at the end of the heat.

Sulfur is eliminated from steel mainly through the formation of manganese sulfide, which separates from solution in the liquid bath and slowly rises to the surface. When in contact with a basic slag the manganese sulfide will react to form calcium sulfide, which remains in the slag. As lime may be added only to basic furnaces, acid furnaces will not remove sulfur. Manganese in pig iron is desirable in removing sulfur and should be relatively high.

Ferromanganese.—The domestic output of ferromanganese increased only slightly over 1943—from 702,484 tons in 1943 to 702,632 tons in 1944. Ferromanganese was produced at the following plants during the year:

Bethlehem Steel Co., Johnstown and Bethlehem, Pa.
E. J. Lavino & Co., Reusens, Va. and Sheridan, Va.
Sloss-Sheffield Steel & Iron Co., North Birmingham, Ala.
Tennessee Products Corp., Rockdale and Rockwood, Ala.
U. S. Steel Corp., various plants.
Electro-Metallurgical Co., various plants.

Ten percent of the total manganese ore used in 1944 for the production of ferromanganese was of domestic origin compared with 14 percent in 1943. Based on the relative manganese content of foreign and domestic ore, 12 percent of the ferromanganese was made from domestic ore in 1944. The recovery of manganese from ore in making ferromanganese was 85.76 percent in 1944 compared with 85.26 percent in 1943.

Ferromanganese and spiegeleisen imported into and made from domestic and imported ores in the United States, 1943-44, in short tons

	1943		1944	
	Alloy	Manga- nese	Alloy	Manga- nese
Ferromanganese:				
Imported.....	2,302	990	4,199	3,308
Domestic production.....	702,484	554,828	702,632	552,429
From domestic ore ¹	124,621	98,426	84,316	66,291
From imported ore ¹	577,863	456,402	618,316	486,138
Total.....	704,786	555,818	706,831	555,737
Ratio (percent) of Mn in ferromanganese of domestic origin to total Mn in ferromanganese made and imported.....		17.71		11.93
Number of plants making ferromanganese.....	11		(²)	
Spiegeleisen:				
Imported.....	3,254	1,651	3,761	1,752
Domestic production.....	149,036	28,954	165,530	32,420
From domestic ore.....	149,036	28,954	164,563	32,231
From imported ore.....			1,967	189
Total.....	152,290	29,605	169,291	33,172
Ratio (percent) of Mn in spiegeleisen of domestic origin to total Mn in spiegeleisen made and imported.....	97.86	97.80		97.16
Number of plants making spiegeleisen.....	6		(²)	
Total available supply of metallic manganese in ferromanganese and spiegeleisen.....		585,423		588,909
Percent of available supply of manganese in—				
Ferromanganese and spiegeleisen imported.....		0.28		0.69
Ferromanganese made from imported ore.....		77.96		82.55
Spiegeleisen made from imported ore.....				0.03
Ferromanganese made from domestic ore.....		16.81		11.26
Spiegeleisen made from domestic ore.....		4.95		5.47
Ferromanganese and spiegeleisen made from domestic ore.....		21.76		16.73
Spiegeleisen made and imported.....		5.06		5.63
Total open-hearth, Bessemer, and electric steel.....	88,836,366		89,641,575	

¹ Estimated.

² Data not available.

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1940-44

Year	Ferromanganese produced			Materials consumed (short tons)				Manga- nese ore used per ton of ferroman- ganese made (short tons)
	Short tons	Manganese contained		Manganese ore (35 percent or more Mn, natural)		Iron and manga- niferous iron ores	Cinder, scale, and per- chased scrap	
		Percent	Short tons	Foreign	Domestic			
1940.....	514,682	79.45	408,903	976,332	13,419	5,889	8,868	1.923
1941.....	580,704	79.48	461,539	1,122,187	9,414	5,166	6,031	1.949
1942.....	661,338	79.01	522,553	1,273,596	17,572	19,545	4,634	1.952
1943.....	702,484	78.98	554,828	1,181,929	199,567	1,684		1.967
1944.....	702,632	78.62	552,429	1,224,878	130,886	1,985	-----	1.930

*Manganese ore used in manufacture of ferromanganese in the United States, 1940-44,
by sources of ore*

Source of ore	1940		1941		1942		1943		1944	
	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content (percent)
Domestic.....	13,419	55.89	9,414	41.61	17,572	39.69	199,567	57.86	130,886	59.06
Foreign:										
Africa.....	233,370	45.89	221,940	47.11	274,450	46.61	340,985	45.21	290,684	46.19
Brazil.....	189,389	42.39	328,769	42.29	342,538	41.55	254,215	39.72	227,410	41.02
Canada.....							44	45.00		
Chile.....	6,076	46.13	4,715	45.81	5,677	46.64	5,837	48.95	464	45.47
Cuba.....	112,859	48.59	135,581	48.47	171,029	46.33	194,784	45.91	241,582	47.45
India.....	188,079	49.73	1250,425	49.85	340,096	49.75	255,897	49.10	246,044	49.36
Java.....					2,189	46.28				
Mexico.....			1,755	46.27	2,013	45.31	10,436	41.03	46,495	41.15
New Zealand.....									536	44.35
Philippine Islands.....	12,768	47.16	6,236	48.32	19,741	46.05	27,233	46.04	8,144	52.00
U. S. S. R.....	187,286	47.85	145,325	48.12	64,051	48.06	3,129	45.19		
Undistributed.....	46,505	38.75	127,441	46.26	151,812	45.75	189,373	49.21	163,519	48.58
	989,751	46.45	1,131,601	46.54	1,291,168	45.99	1,381,496	47.11	1,355,764	46.28

¹ Tonnage entered under "Undistributed" comprises ore from India and U. S. S. R.; separation as to source not reported by consumer.

² Source of ore not reported by consumer.

³ "Orient" reported by consumer as source of ore.

Shipments of ferromanganese in 1944 decreased 1 percent in quantity and 2 percent in value from 1943. The record of shipments for the past 5 years follows:

Ferromanganese shipped from furnaces in the United States, 1940-44

Year	Short tons	Value	Year	Short tons	Value
1940.....	503,291	\$42,755,485	1943.....	722,658	\$93,481,580
1941.....	619,395	69,378,004	1944.....	715,059	91,406,229
1942.....	659,219	82,726,298			

Imports for consumption of ferromanganese increased 82 percent from 1943, and exports decreased 96 percent.

Ferromanganese imported into and exported from the United States, 1940-44

Year	Imports for consumption			Exports ¹	
	Gross weight (short tons)	Mn content (short tons)	Value	Gross weight (short tons)	Value
1940.....	11,613	9,601	\$1,321,369	14,600	\$1,366,087
1941.....	7,032	5,696	557,150	5,155	771,576
1942.....	14,772	11,635	1,274,749	7,165	976,923
1943.....	2,302	990	160,600	12,510	1,717,888
1944.....	4,199	3,308	394,641	600	101,445

¹ 1940-41: Includes spiegeleisen; not separately classified before July 1, 1941.

*Ferromanganese imported for consumption in the United States, 1943-44,
by countries*

Country	1943			1944		
	Gross weight (short tons)	Mn content (short tons)	Value	Gross weight (short tons)	Mn content (short tons)	Value
Canada.....				2,791	2,232	\$206,359
India and Dependencies.....	2,302	990	\$160,600	1,408	1,076	98,282
	2,302	990	160,600	4,199	3,308	394,641

The quoted price of ferromanganese (delivered Pittsburgh) remained unchanged throughout 1944. The ceiling price at seaboard of \$135.00 per long ton (\$120.54 per short ton) also was unchanged.

Prices per short ton of ferromanganese in the United States, 1942-44, by months ¹

Month	1942	1943	1944	Month	1942	1943	1944
January.....	\$111.90	\$125.58	\$125.29	July.....	\$125.58	\$125.29	\$125.99
February.....	111.90	125.58	125.29	August.....	125.58	125.29	125.99
March.....	111.90	125.58	125.29	September.....	125.58	125.29	125.99
April.....	111.90	125.58	125.29	October.....	125.58	125.29	125.99
May.....	125.58	125.58	125.29	November.....	125.58	125.29	125.99
June.....	125.58	125.29	125.29	December.....	125.58	125.29	125.99

¹ Steel, vol. 116, Jan. 1, 1945.

Spiegeleisen.—Production of spiegeleisen increased 11 percent over 1943; shipments increased 3 percent in quantity and 0.5 percent in value.

Spiegeleisen produced and shipped in the United States, 1940-44

Year	Pro-duced (short tons)	Shipped from furnaces		Year	Pro-duced (short tons)	Shipped from furnaces	
		Short tons	Value			Short tons	Value
1940.....	114,119	119,512	\$3,487,565	1943.....	149,036	150,136	\$4,827,954
1941.....	177,915	181,777	5,793,481	1944.....	165,530	155,325	4,851,490
1942.....	186,026	186,163	5,931,728				

Spiegeleisen was manufactured at the following plants during 1944:

Inland Steel Co., East Chicago, Ind.
New Jersey Zinc Co., Palmerton, Pa.
U. S. Steel Corp., various plants.

In addition to the foregoing plants, shipments were made by E. J. Lavino & Co., Reusens, Va., and Sheridan, Pa., and Sloss-Sheffield Steel Iron Co., North Birmingham, Ala.

Most of the spiegeleisen produced in the United States is made from domestic raw materials. However, 534 tons of Portuguese West African ore containing (natural) 49.60 percent manganese were consumed in the production of spiegeleisen during 1944. Imports of spiegeleisen for consumption in 1944 increased 16 percent in quantity and 9 percent in value over 1943. The total supply came from Canada.

Spiegeleisen imported for consumption in the United States, 1940-44

Year	Short tons	Value	Year	Short tons	Value
1940.....	17,455	\$638,732	1943.....	3,254	\$140,247
1941.....	4,741	215,108	1944.....	3,761	153,032
1942.....	1,990	95,853			

The prices of spiegeleisen (20-percent) at producers' furnaces, as quoted by Steel, remained constant at \$36.00 per long ton (32.14 per short ton) during 1944.

Manganiferous pig iron.—Pig-iron blast furnaces used 24,462 tons of manganiferous zinc residuum and a total of 1,357,408 tons of domestic ore containing over 5 percent (natural) manganese in 1944; of this ore, none contained 35 percent or more manganese, 108,915 tons contained 10-35 percent manganese, and 1,248,493 tons contained 5-10 percent manganese. In addition, 19,871 tons of foreign ore containing over 35 percent manganese and 1,844 tons containing 10-35 percent manganese were used during the year.

Foreign ferruginous manganese ore and manganiferous iron ore consumed in the United States, 1942-44, in short tons

Source of ore	Ferruginous manganese ore			Manganiferous iron ore		
	1942	1943	1944	1942	1943	1944
Australia.....				790		
Brazil.....	9,173					
Cuba.....	4,777	9,509	1,844			
Sweden.....				990		
	13,950	9,509	1,844	1,780		

BATTERY AND MISCELLANEOUS INDUSTRIES

Manganese ore for battery use should have a high content of available oxygen with minimum iron and be relatively free from such metals as arsenic, copper, nickel, or cobalt, which are electronegative to zinc. Chemical ore has a wide range in analyses and a great many uses; the bulk is used in photography (in the manufacture of hydroquinone), in fertilizers, and in coloring agents for paints and ceramics.

Data covering production, imports, consumption, and stocks of such ores are given elsewhere in this chapter.

PRICES

Prices of manganese ore (except battery and chemical ore) are upon a unit basis, the unit being 1 percent of a long ton or 22.4 pounds of contained manganese. Prices of chemical ore are quoted upon a per-ton basis, with a minimum requirement of manganese dioxide. A duty of one-half cent per pound of contained manganese is imposed on all imported manganese ore except that from Cuba and the Philippine Islands, which enters duty free.

Ceiling prices on manganese ore were unchanged throughout 1944. However, on May 15 the Metals Reserve Company prices were lowered 5 cents per long-ton unit in the Eastern (Norfolk, Baltimore,

Philadelphia, and New York) and Western (Fontana, Pueblo, and Provo) areas—from 90 cents and 96 cents to 85 cents and 91 cents, respectively. The old price of 85 cents at Mobile and New Orleans remained unchanged.

The average mine value reported for ore containing 35 percent or more manganese during 1944 was 76 cents per long-ton unit compared with 73 cents in 1943. Quotations on imported ore in the following table are from Engineering and Mining Journal.

Domestic prices of imported metallurgical manganese ore in 1944, in cents per long ton unit

[C. i. f. North Atlantic ports, cargo lots, exclusive of duty]

	Begin- ning of year	End of year		Begin- ning of year	End of year
Brazilian, 48 percent Mn.....	\$0.788	\$0.738	Cuban (not dutiable), 48 per- cent Mn.....	\$0.900	\$0.850
Chilean, 48 percent Mn.....	.788	.738	Indian:		
South African, 48 percent Mn.....	.788	.738	50 percent Mn.....	.798	.748
Cuban (not dutiable), 51 per- cent Mn.....	.915	.865	48 percent Mn.....	.788	.738

According to Engineering and Mining Journal, prices for chemical ores per long ton in carlots at the end of 1944 were as follows: Brazilian or Cuban, 80 percent MnO_2 , \$55.00; Javan or Caucasian, 85 percent minimum, \$70 to \$75; domestic, 70 to 72 percent, \$45 to \$50 f. o. b. mines.

WORLD PRODUCTION

Manganese ore produced in principal countries of the world, 1938-44, in metric tons

[Compiled by B. B. Waldbauer]

Country ¹	Percent Mn	1938	1939	1940	1941	1942	1943	1944
North America:								
Canada (shipments).....			359	138	(?)	395	44	(?)
Costa Rica.....	50	304	(?)	(?)	(?)	(?)	(?)	(?)
Cuba.....	36-50+	123,844	102,415	119,852	251,385	249,255	311,214	257,864
Mexico (metal content).....	44	117	27	307	979	11,493	22,945	29,070
United States:								
Continental (shipments).....	35-38	25,727	29,777	40,767	79,646	173,043	186,129	224,632
Puerto Rico (exports).....	48-51	1,039						
South America:								
Argentina.....	35-38	437	651	710	1,476	1,424	(?)	(?)
Bolivia (exports).....	50		500		(?)	600	17	(?)
Brazil.....	38-50	306,025	257,752	313,391	437,402	306,241	275,552	146,983
Chile.....	40-50	19,319	12,550	11,620	35,815	71,292	114,074	(?)
Peru.....		24	96	283	30	174	159	(?)
Europe:								
Bulgaria.....	30-45	1,887	944	2,000	(?)	(?)	(?)	(?)
Germany.....	30+	163	(?)	(?)	(?)	(?)	(?)	(?)
Greece.....	30+	7,075	11,178	(?)	(?)	(?)	(?)	(?)
Hungary.....	35-48	22,221	(?)	(?)	(?)	(?)	(?)	(?)
Italy.....	34-37	48,282	44,986	(?)	(?)		(?)	(?)
Portugal.....	35-45	1,008	353	1,059	1,815	6,820	12,611	5,237
Rumania.....	30-36	60,256	41,546	(?)	(?)	35,000	38,000	(?)
Spain.....	40+	1,319	4,711	5,865	9,923	19,698	24,027	30,322
Sweden.....	30-50	5,347	5,934	4,600	(?)	(?)	(?)	(?)
U. S. S. R.....	41-48	2,272,800	(?)	2,800,000	2,393,000	1,823,000	(?)	461,000
Yugoslavia.....	32-38	3,759	5,655	(?)	4,724	(?)	(?)	(?)

See footnotes at end of table.

Manganese ore produced in principal countries of the world, 1938-44, in metric tons
—Continued

Country ¹	Percent Mn	1938	1939	1940	1941	1942	1943	1944
Asia:								
China (exports)	45-46	1,247	1	(?)	(?)	(?)	(?)	(?)
India:								
British	47-52	983,464	858,220	882,947	797,939	768,972	(?)	(?)
Portuguese	42-50+	9,478	8,204	6,525	8,111	680	(?)	(?)
Indochina		2,214	2,440	2,000	(?)	(?)	(?)	(?)
Iran ²	45-55	(?)	(?)	2,320	3,270	1,800	(?)	(?)
Japan	49-51	80,000	(?)	(?)	(?)	(?)	(?)	(?)
Netherlands Indies	50-55	9,687	12,074	11,569	(?)	(?)	(?)	(?)
Philippine Islands	45-50	58,143	29,394	52,166	50,570	(?)	(?)	(?)
Turkey	30-50	2,186	3,339	460	1,360	3,313	2,687	(?)
Unfederated Malay States	30	32,483	31,952	11,702	(?)	(?)	(?)	(?)
Africa:								
Belgian Congo	50+	7,725	(?)	18,369	25,300	13,900	17,413	(?)
Egypt	30+	153,112	119,882	64,912	2,175	8,169	7,079	30
Gold Coast	50+	408,452	388,131	442,998	498,881	691,016	534,362	512,554
Morocco:								
French	40-50+	86,597	75,389	104,713	50,722	44,273	48,994	(?)
Spanish	38	152	(?)	(?)	(?)	(?)	(?)	(?)
Northern Rhodesia	30-48	2,779	3,018	3,550	4,775	(?)	(?)	(?)
Union of South Africa	30-51	551,739	419,697	412,071	445,893	394,445	219,122	56,055
Oceania:								
Australia:								
New South Wales		221	148	1,024	1,485	793	614	(?)
Queensland		382		387	209	(?)	(?)	(?)
South Australia			7	10,827	11,405	9,477	5,680	(?)
New Zealand		91	494	996	764	326	518	500
Papua ³			55	198	408	(?)	(?)	(?)
		5,291,000	5,169,000	(?)	(?)	(?)	(?)	(?)

¹ In addition to countries listed Belgium produces manganese ore, but data of output are not available. Czechoslovakia reports a production of manganese ore, but as it has been ascertained that the product so reported averages less than 30 percent Mn and therefore would be considered ferruginous manganese ore under the classification used in this report, the output has not been included in the table.

² Data not available.

³ Estimate included in total.

⁴ Dry weight.

⁵ Shipments by rail and river.

⁶ Exports.

⁷ January to September, inclusive.

⁸ Estimate.

⁹ Estimate excludes Ukraine.

¹⁰ Croatia only.

¹¹ Fiscal year ended March 20 of year stated.

¹² January to June, inclusive.

¹³ Fiscal year ended June 30 of year stated.

U. S. S. R.

The Nikopol manganese district was retaken by Soviet forces on February 8, 1944, after 2½ years of German occupation. However, demolition by the enemy and other results of the war prevented any important production from that district during 1944, and output of the U. S. S. R., normally the World's largest producer, was the lowest in 20 years. The manganese ore of the Soviet Union occurs largely in the Republics of Georgia and Ukraine. A discussion of the two main districts follows:

Chiaturi.—This district is situated in the Republic of Georgia on the southern slope of the Caucasus Mountains near Chiaturi and normally supplies most of the Soviet Union's export ore.

The manganiferous beds, which are horizontal and continuous, vary in thickness from 4 to 9 feet, and the ore itself is 3 to 5 feet thick. Sandstone composes both the roof and the floor. The method of working is a form of longwall retreating, galleries being driven in the ore beds and ore being extracted on either side up to the pillars which are left to protect the entry. Since they are practically horizontal, galleries begin on one side of the ridge and pass out at the other almost

at the same level; some of them attain a length of 4,000 feet. The mines are usually dry, and only light explosives are used, where necessary, in breaking down the ore. Generally speaking, the richest ore beds are found in the central field, those in the outside diminishing both in quality and quantity. The ores are treated at plants erected in the valleys and transported by aerial ropeway to storage bins at the Chiaturi rail sidings.

The ore is composed of pyrolusite with some psilomelane and wad. The average manganese content of the crude ore is about 40 percent, and about $2\frac{1}{2}$ or 3 tons of crude ore produce 1 ton of concentrate. The concentrates produced have a manganese content ranging from 44 to 52 percent and are produced by log-washing and jigging. The ore shipped is so high in fines that much of it is unsuitable for use in blast furnaces unless mixed with other ores or sintered.

During the German occupation of the Ukraine Republic, the U. S. S. R. depended on Georgian ores for its own requirements, and none was available for export. United States imports of Chiaturi manganese ore ceased in 1940.

Nikopol.—This district is on the east bank of the Dnieper River, below the town of Zaporozhe in the Ukraine and about 100 miles from the Gulf of Odessa. The field is divided into an eastern and a western section by a zone of crystalline rocks barren of ore. The western section covers an area about 12 miles long and 6 miles wide. In the eastern section the limits of five ore bodies have been defined, all of similar type and each covering an area of a few square miles.

The ore bed is horizontal and varies in thickness from 3 to $11\frac{1}{2}$ feet, averaging $6\frac{1}{2}$ feet. As at Chiaturi, it consists of clay mixed with powdered manganese ore, enriched by oölites and nodules of pyrolusite and psilomelane varying in diameter from a fraction of an inch to 19 inches. Other ore minerals present are wad, limonite, and hematite. The mines are worked at depths of 50 to 280 feet by underground methods similar to those at Chiaturi.

The ore as mined runs from 20 to 36 percent manganese and averages 30 percent. Where possible, the ore is hand-sorted before going to the concentrating plant, where it is crushed, washed, and concentrated with jigs and tables or by flotation. About 3 tons of crude ore are required to make 1 ton of concentrate running from 40 to 50 percent manganese.

Whereas Chiaturi normally supplies most of the ore for export, Nikopol supplies domestic demands. Normal production from Nikopol is over a million tons per year. In 1900 N. A. Sokolov estimated the ore reserves of Nikopol district at 50,000,000 tons; in 1931 P. I. Vasilenko estimated a total of 398,000,000 tons.

CHROMITE

By EDWIN K. JENCKES AND KATHARINE D. WILDENSTEINER

SUMMARY OUTLINE

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SUMMARY

The year 1944 was featured by decreases in the domestic production, importation, and consumption of chromite. Exports were at the lowest level since their separate reporting was begun in July 1941. The net effect of these changes was an increase of 44,551 tons in the total apparent stocks of chromite, although the stocks in the hands of industry decreased during the year by 67,100 short tons to 303,200 tons.

Salient statistics of chromite in the United States, 1943-44

	1943		1944	
	Short tons	Value	Short tons	Value
New supply:				
Domestic production (shipments)	160, 120	\$4, 820, 461	45, 629	\$1, 668, 299
Imports for consumption	928, 576	16, 432, 717	848, 390	15, 959, 992
Total	1, 088, 696	21, 253, 178	894, 019	17, 628, 291
Distribution:				
Consumption by industry	964, 600	(¹)	848, 449	(¹)
Exports	26, 259	896, 174	1, 019	43, 601
Additions to stocks ¹	97, 837	(¹)	44, 551	(¹)
Total	1, 088, 696	21, 253, 178	894, 019	17, 628, 291

¹ Not available.

¹ Calculated to strike a balance.

POSTWAR OUTLOOK

There seems to be no current reason to revise the estimate in Minerals Yearbook, 1943, that in the postwar period a higher rate of chromite consumption is indicated than in the prewar years.¹ The same imponderable factors that made the 1943 estimate indeterminate remain in 1944. The probability is, however, that postponed civilian demand has increased. The needs of the European countries for the rehabilitation of war-wrecked industries unquestionably have increased, but whether buying power will be forthcoming to translate these needs into consumption remains problematical. It is assured that a market for the tooling of new plant installations (particularly in the case of U. S. S. R.) will be a large factor contributing to increased requirements for chrome-containing steels. Probably the largest demand will manifest itself in the engineering,

¹ Minerals Yearbook, 1943, p. 625.

corrosion-resisting, and heat-resisting alloy steels and other chrome alloys. The effectiveness of these requirements will depend on postwar economic conditions.

In prewar years producers of machine tools, chemical equipment, road-building machinery, and other items were large consumers of chromium. Much similar equipment has been manufactured for war use. It is difficult to estimate, however, the role of this war-purpose equipment in the postwar economy. It seems safe to say that a large amount of machinery of standard design, though manufactured as a war necessity, can find a place in industry with little or no alteration. However, if war-purpose plants are held in "stand-by condition" for any considerable period the effect of this machinery on the immediate postwar market will be less than might be expected.

Under any circumstances large volumes of scrap (both war scrap and unused war materials) are to be expected. If scrap is remelted in the electric furnace a high recovery of chromium will result,² whereas if it is remelted in the open hearth much of the chromium will be oxidized and lost in the slag.

Indications of the character of domestic production compared with the grade of imported ore are given under the section on actions by Metals Reserve Company. There is no reason to expect an increase in the consumption of low-grade domestic production unless and until some commercially feasible method of treatment is established. Twice in the last 30 years domestic production has mushroomed to unprecedented heights in wartime only to decrease rapidly when hostilities cease.

Chromite shipped from mines in the United States, 1913-19 and 1938-44

Year	Short tons	Year	Short tons
1913.....	286	1938.....	909
1914.....	662	1939.....	4,048
1915.....	3,675	1940.....	2,982
1916.....	52,680	1941.....	14,259
1917.....	48,973	1942.....	112,876
1918.....	92,322	1943.....	160,120
1919.....	5,688	1944.....	45,629

Of the domestic chromite delivered to Metals Reserve Company since its purchasing program was begun on November 1, 1941, 269,597 short tons remained in its hands on January 1, 1945, out of 318,427 tons purchased.

GOVERNMENT ACTIONS

Stock-pile legislation.—On October 3, 1944, the Surplus Property Act of 1944 (Public, 457, 78th Congress) was approved by the President. Section 22 of this act, which covers the stock-piling provisions, is discussed in the chapter entitled "Review of the Mineral Industries in 1944" in part I of this volume.

One direct result of this legislation will be to prevent the dumping of Government stocks of surplus chromite on the market at the end of hostilities, provided the stocks are declared surplus before January 2, 1946. The law permits the processing of materials into the form "best-suited to the common defense."

² Iron Age, Electric Furnace Operators Debate Production Problems: Vol. 154, No. 16, Oct. 19, 1944, pp. 66-73.

The Army and Navy Munitions Board has submitted to Congress, in accordance with the Surplus Property Act of 1944, a report recommending—with respect to chromite—the transfer of surplus Government-owned metallurgical and refractory grades of ores and concentrates to stock pile and further acquisition of these grades; and the transfer but not the additional purchase of Government-held material of chemical grade. For security reasons, no quantitative recommendations are included in the published document.

War Production Board.—During 1944 an extremely difficult shipping situation³ threatened the flow of adequate imports of chromite, notably from Southern Rhodesia and the Transvaal. As a result of this condition, the Bureau of Mines, in cooperation with the War Production Board, early in 1945 revised its questionnaire covering the production of chromium products and the consumption of chromite so that it would include data on the consumption of Rhodesian, Turkish, and Russian materials as distinct from all other types and would also classify consumption as lumpy ore, friable fines, or concentrates.

On January 21, 1944, the War Production Board issued Allocation Order M-370 placing under complete allocation chromium oxide green and zinc chromate, while limiting the purchase of the other chrome pigments.⁴

On November 2, 1944, Order M-18-b was replaced by General Allocation Order M-300, Schedule 62. This order covers the allocation of "Primary Chromium Chemicals" which are defined by the order as "sodium bichromate, potassium bichromate, sodium chromate, potassium chromate, ammonium bichromate, chromic acid, and all chromium tanning compounds." Although some minor changes were made, the order substantially continued Order M-18-b. There was no time lapse in the continuity of the two orders.

On January 12, 1944, General Limitation Order L-223 was revoked, removing restrictions on the distribution, sale, and use of hard facing materials. This order affected alloys containing cobalt, chromium tungsten, molybdenum, vanadium, or secondary aluminum. This order had been in effect since December 2, 1942.⁵

On January 15, 1944, Issue 11 of the Material Substitution and Supply List (Conservation Division, W. P. B.), placed ferrochromium in group III (materials readily available for essential uses).

Direction 2 to General Preference Order M-18-a, which became effective on June 28, 1944, prohibited the melting of chromium to make nickel-chrome resistance wire or the delivery of such wire for unauthorized uses.

Office of Price Administration.—Amendment 4 to M. P. R. 258, effective April 15, 1944, exempted from price control sales or deliveries of chrome ores in quantities of 500 pounds or less.

Amendment 5 to M. P. R. 258 was issued on October 2 and became effective on October 7, 1944. This amendment provided for a discount of 7½ percent (but not to exceed \$3.50 a long ton) on concentrates and unscreened ores having certain undesirable physical and chemical properties, specifically to Transvaal B, Russian, and Philippine ores and concentrates.

Metals Reserve Company.—On September 1, 1944, Metals Reserve Company issued schedules covering the purchase (contract or small-

³ Post, Charles T., *Nonferrous Metals: Iron Age*, vol. 155, No. 1, Jan. 4, 1945, pp. 190-192.

⁴ Chemical and Metallurgical Engineering, vol. 51, No. 2, February 1944, p. 90.

⁵ American Metal Market, vol. 51, No. 9, Jan. 13, 1944, pp. 1-2.

lot) of domestic chromite during the period from January 1 to June 30, 1945.

The price schedules in effect in 1944 and during the first 6 months of 1945 are given in the accompanying table.

Metals Reserve Company price schedules of chromite in effect in 1944 and January 1 to June 30, 1945

	1944	Jan. 1-June 30, 1945, inclusive
Base price for ore 48 percent Cr_2O_3 and Cr: Fe ratio 3: 1..... per long ton..	\$52.80	\$52.80
Minimum acceptable analysis:		
Cr_2O_3 percent minimum.....	35	42
Cr: Fe ratio..... minimum.....	$1\frac{1}{2}$:1	2:1
SiO_2 percent maximum.....		10
Premiums:		
For each 1 percent of Cr_2O_3 in excess of 48 percent..... per long ton.....	\$1.10	\$1.10
For each 0.1 in ratio above 3: 1 not to exceed $3\frac{1}{2}$: 1..... do.....	1.50	1.50
Penalties:		
For each 1 percent Cr_2O_3 below 48 percent down to limiting acceptable analysis..... do.....	1.10	1.10
For each 0.1 in ratio below 3: 1 down to 2: 1..... do.....	1.50	1.50
For ratio below 2: 1 down to $1\frac{1}{2}$: 1..... do.....	15.00	

¹ Plus \$1 per ton for each decrease of 0.1 below 2: 1.

On December 31, 1944, Metals Reserve Company had in its possession 834,564 short tons of chromite held in stock pile at purchase depots and by agencies. The composition of these stocks, by Cr_2O_3 content and by domestic or foreign origin, is given in the accompanying table.

Metals Reserve Company stocks of chromite in storage in the United States including materials available for allocation and held at purchase depots and by agents, on Dec. 31, 1944, in short tons

	Cr_2O_3 , percent					Total tonnage
	Over 48.00	45.00 to 47.99	42.00 to 44.99	35.00 to 41.99	Less than 35.00	
Ore at M. R. C. stock piles (exclusive of purchase depots and agencies).						
Metallurgical grade:						
Imported.....	271,011	25,231	3,400	9,860		309,502
Domestic.....		25,612	45,322	52		70,986
	271,011	50,843	48,722	9,912		380,486
Chemical grade:						
Imported.....	3,056	208	10,329			13,593
Domestic.....			627	91,949		92,576
	3,056	208	10,956	91,949		106,169
Refractory grade:						
Imported.....				95,038	146,834	241,872
Domestic.....						
				95,038	146,834	241,872
Domestic ore at purchase depots and agencies (unclassified as to use grade).						
Purchase depots:						
Ore.....	2,718	7,530	2,224	31,511		43,983
Concentrates.....	42	207	784	1,036		2,069
Agencies:						
Primary concentrates.....					59,983	59,983
	2,760	7,737	3,008	32,547	59,983	106,035
Total imported.....	274,067	25,439	13,729	104,898	146,834	564,967
Total domestic.....	2,760	33,349	48,957	124,548	59,983	269,597
Grand total.....	276,827	58,788	62,686	229,446	206,817	834,564

Total Metals Reserve Company sales of domestic chromite during 1944 amounted to 14,164 short tons. The tenor of this domestic ore and concentrates sold was as follows:

Cr ₂ O ₃ content (percent):	Short tons sold
Over 48.00.....	7,710
45.00 to 47.99.....	4,743
42.00 to 44.99.....	1,225
35.00 to 41.99.....	486
	14,164

Total sales of chromite by Metals Reserve Company are shown in the accompanying table.

Sales of domestic and imported chromite by Metals Reserve Company, 1941-44, in short tons

Year	Foreign	Domestic	Total
1941.....	9,697		9,697
1942.....	105,838	14,598	120,436
1943.....	158,975	20,068	179,043
1944.....	319,205	14,164	333,369
	593,715	48,830	642,545

MARKET AND PRICES

During 1944 Metals Reserve Company has continued to be the major purchaser of domestic chromite, as it has been since November 1941.

Maximum Price Regulation 258, covering commercial transactions noted under Government Actions, was in effect during the year. This schedule of prices will be found in the Minerals Yearbook, 1942, p. 633.

Prices quoted by E. & M. J. Metal and Mineral Markets for various grades of chromite remained unchanged during the year.

E. & M. J. Metal and Mineral Markets price quotations for various grades of chromite in 1944, per long ton

	Cr ₂ O ₃ , percent	Cr:Fe ratio	Price
African and Indian.....	48	2.8:1	\$41.00
Do.....	48	3:1	43.50
Do.....	48		31.00
South African: Transvaal.....	44		27.40
Do.....	45		28.30
Do.....	48		31.00
Do.....	50		32.80
Brazilian.....	44	2½:1	33.65
Do.....	48	3:1	43.50
Rhodesian.....	45		28.30
Do.....	48		31.00
Do.....	48	3:1	43.50
Domestic.....	48	3:1	43.50

¹ Less \$7 per ton freight allowance.

UNITED STATES

PRODUCTION IN 1944

The domestic production of chromite in 1944, in terms of shipments from mines, fell to a figure of 45,629 short tons, the lowest since 1941. California furnished 76 percent of the total output, Oregon 17 percent, and Alaska and Montana the remainder.

Chromite production (shipments) in the United States, 1941-44, by States, in short tons, and number of producers in 1944

State	1941	1942	1943	1944				Total
				Number of pro- ducers	Cr ₂ O ₃ , percent			
					45 or more	35 to 44	Under 35	
Alaska			5,569	1		1,845		1,845
California	13,419	44,873	62,495	115	11,225	23,212	278	34,715
Idaho		25						
Montana		65,238	75,691	1		1,251		1,251
Oregon	840	2,683	16,363	27	4,001	3,817		7,818
Texas			2					
Washington		57						
Total	14,259	112,876	160,120	144	15,226	30,125	278	45,629

Chromite production (shipments) in the United States in 1944, by form of material, percentage of Cr₂O₃, and size of individual operation, in short tons

	Cr ₂ O ₃ , percent			Total
	45 or more	35 to 44	Under 35	
Form of material:				
Ore	11,041	18,094	278	29,413
Concentrates	4,185	12,031		16,216
Size of individual operation:				
10,000 tons or more	282	10,615		10,897
5,000 to 10,000 tons	5,101	7,695		12,796
1,000 to 5,000 tons	6,058	4,110		10,168
500 to 1,000 tons	918	2,670		3,588
Less than 500 tons	2,867	5,035	278	8,180

*Alaska.*⁶—The Chrome Queen Mining Co. resumed operations in May 1944 at its Chrome Queen mine on Kenai Peninsula near Seldovia, after closing during the winter months on account of weather conditions. Shipments for the year totaled 1,845 short tons, averaging 43 percent Cr₂O₃, with a chrome : iron ratio of 2.8 : 1. Operations at the mine ceased with the closing of the Metals Reserve Company purchasing depot at Jakolof Bay on August 15, 1944.

*California.*⁷ ⁸—Although chromite was shipped from 22 counties in California in 1944, most of it came from properties in the following counties: Del Norte, Eldorado, Fresno, Glenn, Humboldt, Placer, San Luis Obispo, Shasta, Siskiyou, and Tehama.

⁶ Julihn, C. E., and Moon, Lowell B., Summary of Bureau of Mines Exploration Projects on Deposits of Raw Material Resources for Steel Production: Bureau of Mines Rept. of Investigation 3801, 1945, p. 4.

⁷ Rynearson, G. A., and Wells F. G., Geology of the Grey Eagle and Some Nearby Chromite Deposits in Glenn County, Calif.: Geol. Survey Bull. 945-A, 1944, 22 pp.

⁸ Smith, Clay T. and Griggs, Allan B., Chromite Deposits Near San Luis Obispo, San Luis Obispo County, Calif.: Geol. Survey Bull. 945-B, 1944, pp. 23-44.

The Castro group of mines in San Luis Obispo County, operated by the Castro Chrome Associates, was the largest producer of chromite in California. The output in 1944—of which 97 percent was in the form of concentrates—totaled 10,897 short tons. The concentrates averaged 43 percent Cr_2O_3 with, a chrome : iron ratio of 2.6 : 1. The mill, located at Goldtree Siding, suspended operations late in 1944.

The second-largest producer was the French Hill mine,⁹ operated by Tyson Chrome Mines, Ltd. The mine is about 22 miles northeast of Crescent City in Del Norte County. Shipments from this property totaled 6,906 short tons averaging 43 percent Cr_2O_3 and 12 percent iron.

Shipments of high-grade ore from the High Plateau mine in Del Norte County continued in 1944. The mine was owned and operated by Eugene R. and Beatrice Brown.

Shipments of concentrates in 1944 from the Grey Eagle property in Glenn County, which for 2 successive years was the largest chromite producer in California, dropped to 3,528 short tons, averaging 47 percent Cr_2O_3 and 15 percent iron. Operations by the Rustless Mining Corp. ceased early in 1944 because of exhaustion of commercial ores.

Montana.—The Silver Star Chrome Co., operating the Mohawk mine and mill in Madison County, was the only Montana producer in 1944. Production amounted to 1,251 short tons, averaging 37 percent Cr_2O_3 . The mine and mill closed in May 1944 upon cancellation of Government contract.

Oregon.—Chromite was shipped in 1944 from mines in Curry, Grant, Jackson, and Josephine Counties.

The largest producer was the Oregon Chrome mine in Josephine County, owned by the Oregon Chrome Mines, Inc., and leased to William S. Robertson. Total production amounted to 5,890 short tons averaging 45 percent Cr_2O_3 and 11 percent iron. In addition to maintaining regular production, Robertson conducted a development program.¹⁰

EXPLORATION AND DEVELOPMENT

In March 1945 the Bureau of Mines issued Report of Investigations 3801, covering the Bureau's exploration work on a number of strategic minerals, including chromium, carried out during the fiscal years 1940-44. Individual projects examined were:

California: Seiad Creek, Siskiyou County; Little Castle Creek, Shasta County; Grey Eagle, Glenn County; San Luis Obispo, San Luis Obispo County; McGuffey Creek Chromite, Siskiyou County; Coggin Property, Siskiyou County; McCormick Property, Tuolumne County; French Hill, Del Norte County.

Georgia: Louise Chromite, Troup County.

Montana: Benbow-Mouat Properties, Stillwater County; Gish Area of Stillwater Complex, Sweetgrass County; West Fork Area, Sweetgrass County.

Oregon: John Day Area, Grant County; Sourdough Area, Curry County; Oregon Beach Sands, Coos County.

Pennsylvania: Oxford Property, Chester and Lancaster Counties.

Wyoming: Casper Mountain, Natrona County.

Alaska: Red Mountain, Kenai Peninsula; Knik Valley Deposits, Southwestern Alaska.

⁹ Julihn, C. E., and Moon, Lowell B., Summary of Bureau of Mines Exploration Projects on Deposits of Raw Material Resources for Steel Production: Bureau of Mines Rept. of Investigations 3801, 1945, p. 3.

¹⁰ Mining Journal (Arizona), vol. 28, No. 9, Sept. 30, 1944, p. 30.

The Geological Survey continued its program of mapping the principal active chromite mines, which include, in California, the McCormick (Tuolumne County), French Hill (Del Norte County), and High Plateau (Del Norte County) mines and, in Oregon, the Oregon Chrome (Josephine County) mine. The work on the McCormick and French Hill mines was done in conjunction with the Bureau of Mines.

The Geological Survey program in Cuba was continued in cooperation with the Foreign Economic Administration. Geologic mapping in the Camaguey district was completed, with results that are encouraging for future geophysical prospecting. Information on the mines in Oriente Province was kept current, with mapping of the larger mines in the Moa and Mayari districts and some reconnaissance mapping.

No extensive investigations of chromite deposits in Alaska were made by the Geological Survey in 1944. Several of the chromite deposits at Red Mountain, Kenai Peninsula, were briefly examined by the Geological Survey in connection with a Bureau of Mines exploratory project in that area.

During the year reports were published on the Grey Eagle and nearby deposits in Glenn County, Calif.,¹¹ and deposits in San Luis Obispo County, Calif.¹²

HISTORICAL SURVEY OF SUPPLY

A survey of the relative growth of total supply, of domestic production, and of the relation of domestic production to total supply for 5-year periods from 1891 to 1943 is given on page 632 of Minerals Yearbook, 1943. The details, in tonnages, for 1940-44 are given in the accompanying table.

Total supply, imports for consumption, domestic production, and consumption of chromite, 1940-44, in short tons

	1940	1941	1942	1943	1944
Total supply.....	739,594	1,129,551	1,094,483	1,088,696	894,019
Imports for consumption.....	736,612	1,115,292	981,607	928,576	848,390
Domestic production.....	2,982	14,259	112,876	160,120	45,629
Consumption by industry.....	562,915	800,290	891,952	964,600	848,449

CONSUMPTION

Consumption of chromite declined to 848,449 short tons in 1944 from the all time high of 964,600 tons in 1943, a decrease of 12 percent.

As was to be expected, the pressure of wartime demand resulted in a decrease in the tenor of ore consumed; with the subsequent decline in consumption, the demand for higher-content ores has become operative. The accompanying table shows consumption by primary consumer groups and the tenor of ore for the period 1940-44.

¹¹ Rynearson, G. A., and Wells, F. G., *Geology of the Grey Eagle and Some Nearby Chromite Deposits in Glenn County, Calif.*: Geol. Survey Bull. 945-A, 1944, pp. 1-22.

¹² Smith, Clay T., and Griggs, Allan B., *Chromite Deposits Near San Luis Obispo, San Luis Obispo County, Calif.*: Geol. Survey Bull. 945-B, 1944, pp. 23-44.

Consumption of chromite and tenor of ore used by primary consumer groups in the United States, 1940-44, in short tons

Year	Total chromite consumed		Tenor of ore (percent Cr_2O_3)		
	Gross weight (short tons)	Average tenor (percent Cr_2O_3)	Metallurgical	Refractory	Chemical
1940.....	562,915	45.0	50.5	35.8	47.2
1941.....	800,290	44.3	50.1	34.8	46.3
1942.....	891,952	43.2	48.5	34.0	44.8
1943.....	964,600	43.8	48.5	34.0	44.7
1944.....	848,449	44.1	49.4	34.2	45.7

During 1944, 14,164 short tons of domestic ore were sold to industry by Metals Reserve Company.

Metallurgical chromite is consumed by the steel industry through two channels—as ferrochromium and as a direct addition to the steel bath. In 1944, 94.1 percent of this grade of ore was consumed in the form of ferrochromium and 5.9 percent as direct additions to the steel bath.

During the war years the American Iron and Steel Institute reports the production of alloy steel as follows: 1941—8,206,129 short tons; 1942—11,526,374; 1943—13,149,818; 1944—10,633,086. The consumption of ferrochromium roughly parallels the production of alloy steel.

A number of articles have appeared in the technical press describing cast-alloy tools containing chromium, which fall in the range between the high-speed-steel types and the sintered carbide alloys. Although this use for chromium metal may not offer a large outlet, it is an interesting technical development.

The consumption of chemical-grade chromite in 1944 increased 0.8 percent over the 1943 figure. During the year much difficulty was experienced in obtaining the preferred grades of Rhodesian and Transvaal chromite because shipping could not be diverted from other services for its movement. Determined efforts were made by the manufacturers of chrome chemicals to use both low-content domestic ores (on an experimental basis) and high-grade Russian material (plant scale). Reports as to the success of these experiments have been conflicting, but it appears that the difficulties are being overcome. The year 1944 has been one of largely increased demands for chrome chemicals, mostly military, and the manufacturers have faced the problem of keeping up the production with the best immediately available ores. Under these conditions neither badly needed manpower nor plant facilities could be diverted to the long time problems of utilization of unfamiliar materials.

Chrome chemicals are used for the following purposes: Tanning of upper leather for combat boots and other military footwear, as well as for civilian shoes; production of camouflage pigments, priming pigments for military aircraft and for Navy and maritime vessels; processing of textiles almost entirely for military needs; treatment of brass for ammunition; plating and anodizing of aircraft parts and frames; manufacture of a number of chemicals, most of which are subject to allocation or directive control; manufacture of pure metallic chromium for special nonferrous alloys used in aircraft and in cutting

tools; production of catalysts used in gasoline and synthetic rubber manufacture; and a number of other items of lesser importance.

The consumption of refractory-grade chromite in 1944 decreased 6.4 percent from the tonnage consumed in 1943.

It is to be hoped that reconquest of the Philippine Islands will permit operation of the chromite mines there and make available the excellent Masinloc refractory ore. During the Japanese control of the islands, dependence for refractory-grade ore has been largely upon South African and Cuban sources.

During the last 5 or 6 years a great deal of work has been done on the development of chrome-magnesia and magnesia-chrome refractories, and it is reported that much brick of these compositions has gone into commercial use.¹³

IMPORTS AND EXPORTS¹⁴

Imports of chromite in 1944 declined for the third successive year from the high of 1941. A total of 848,390 short tons of all grades was a decline of 9 percent from 1943, 14 percent from 1942, and 24 percent from 1941.

Chromite imported for consumption in the United States, 1940-44, by countries

Country	Gross weight (short tons)				1944		
					Short tons		Value
	1940	1941	1942	1943	Gross weight	Cr ₂ O ₃ content	
North America:							
Canada.....	209	393	13,705	17,046	20,296	9,533	\$651,887
Cuba.....	58,190	179,944	137,826	310,729	349,059	123,504	4,206,260
Guatemala.....				2,001	1,016	532	35,309
	58,399	180,337	151,531	329,776	370,371	133,569	4,893,456
South America: Brazil.....	3,125	6,005	6,468	9,285	4,278	2,008	84,352
Europe:							
Cyprus.....				8,400			
Greece.....	15,726	2,199					
U. S. S. R.....			30,061	99,922	112,315	57,816	4,977,099
Yugoslavia.....	1,120						
	16,846	2,199	30,061	108,322	112,315	57,816	4,977,099
Asia:							
India and Dependencies.....	36,561	10,910	21,316	2,800			
Philippine Islands.....	175,354	288,411	30,475				
Turkey.....	78,491	61,845	119,548	90,778	98,777	47,810	2,380,217
	290,406	361,166	171,339	93,578	98,777	47,810	2,380,217
Africa: ¹							
Sierra Leone.....	15,568	16,464					
Southern Rhodesia.....	177,909	269,210	277,272	243,508	187,781	90,251	2,692,968
Union of South Africa.....	126,349	180,703	262,259	111,602	40,376	17,754	337,604
	319,826	475,377	539,531	355,110	228,157	108,005	3,030,572
Oceania: New Caledonia ²	48,010	90,208	82,677	32,505	34,492	16,486	594,296
	736,612	1,115,292	981,607	928,576	848,390	365,694	15,959,992

¹ For change in presentation of data for 1942 and following years see Minerals Yearbook, 1943, p. 634.

² Listed as French Oceania by U. S. Department of Commerce.

³ Austin, Chester R., *Refractories Keep Pace With Industrial Progress: Brick and Clay Record*, vol. 104, No. 1, January 1944, pp. 39-44.

⁴ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

In 1944 the only imports of ferrochromium were from Canada and amounted to 113 short tons (79 short tons chromium content) containing 3 percent or more of carbon. There were no imports of low-carbon ferrochromium, chromium metal, chromic acid, and sodium or potassium dichromate.

Exports of chromite amounted to 1,019 short tons, of which 540 went to Canada, 410 to Brazil, and the balance to Mexico and Union of South Africa.

Exports of ferrochromium were 532 short tons, of which U. S. S. R. received the larger part. Exports of chromium metal were 37 tons, mostly to Canada. During the year 577 short tons of chrome pigments and 188 tons of chromium chemicals were exported.

WORLD PRODUCTION

World production of chromite, 1939-44, by countries, in metric tons

[Compiled by B. B. Waldbauer]

Country	1939	1940	1941	1942	1943	1944
Africa:						
Egypt.....				312	910	
Sierra Leone.....	10,755	17,777	15,131	15,000	16,000	(²)
Southern Rhodesia (exports).....	107,708	279,818	313,308	348,050	266,272	(²)
Union of South Africa.....	160,014	163,646	141,884	337,620	163,232	20,207
Asia:						
Cyprus (exports).....	1,118	2,540	4,816	2,936	7,986	(²)
India.....	49,925	56,402	50,940	50,380	33,789	(²)
Iran.....					435	1,267
Japan.....	(⁶)	(⁶)	(⁶)	(²)	(²)	(²)
Philippine Islands (exports).....	126,749	194,393	300,000	50,000	60,000	(²)
Turkey.....	191,644	169,823	150,303	144,704	196,836	150,000
U. S. S. R.....	(⁶)	(⁶)	(⁶)	400,000	325,000	(²)
Europe:						
Albania.....	3,070	14,000	20,000	5,000	(²)	(²)
Bulgaria.....	4,251	6,000	(⁶)	6,500	7,000	(²)
Greece.....	57,091	33,118	(⁶)	40,000	15,000	(²)
Norway.....	371	(⁶)	(⁶)	(²)	(²)	(²)
Portugal.....					1,267	1,500
United Kingdom (shipments).....	(⁶)	1,200	(⁶)	500	500	(²)
Yugoslavia.....	59,527	71,019	(⁶)	100,000	65,000	(²)
North America:						
Canada.....	1	304	2,152	10,393	26,848	25,147
Cuba.....	50,562	52,347	163,175	286,470	354,152	192,131
Guatemala.....	564	136	697	529	374	97
Mexico.....	(⁶)	(⁶)	12	17		
United States.....	3,672	2,705	12,935	102,400	145,259	41,394
Oceania:						
Australia: New South Wales.....	118	279	356	365	412	(²)
New Caledonia.....	52,000	55,790	45,720	71,120	50,000	(²)
South America:						
Argentina.....			60	210	250	(²)
Brazil (exports).....	3,554	4,572	5,944	5,776	7,813	4,721
Total world production ²	1,132,000	1,466,000	1,805,000	1,978,000	1,744,000	(²)

¹ Exports.

² Estimated.

³ Data not available.

⁴ January to June, inclusive.

⁵ Fiscal year ended March 20 of year stated.

⁶ Estimate included in total.

⁷ Planned production.

⁸ May include some production in Yugoslavia.

Albania.—A recent publication ¹⁶ gives limited information concerning chromite in Albania. There are indications of deposits in the Shebenik and Martaneshi Mountains southeast of Elbasan and west of Pogradec. Fifty-seven thousand tons of chromite reported to contain 45 percent Cr₂O₃ were exported from the Kuitza area of the

¹⁶ The Albanian Master in His Home, Tirana, 1944, Printing House "Gurakuqi."

village districts near Pogradec. The exploitation was by an Italian firm.

Argentina.—In January it was proposed that a company be formed to exploit Argentine chromite deposits.¹⁶ The Review of the Bank of South America¹⁷ published an announcement by the Argentine Ministry of War that a mixed company, partly Government and partly privately owned, has been formed to exploit chrome deposits in the Province of Cordoba. The company is capitalized at 2,500,000 pesos, two-fifths to be supplied by the Department of Military Factories and the balance by a group of nine private shareholders. The Argentine Government hoped that, once plants are installed, supplies will be available to cover the country's entire needs.¹⁸

A decree issued November 15, 1944, proposed by the Ministry of War, forbids the exportation of chrome minerals in any of their forms or degrees of concentration.¹⁹

Australia.—Deposits of chrome ore at Tungamull in the Rockhampton district of Queensland have been recognized for some time,^{20 21} and it is reported that between January and May 1944, 389 tons were mined and shipped to Newcastle, New South Wales. Samples from the Elgalla workings, Tungamull lodes, assayed by a Government analyst, ran 36.2 percent Cr_2O_3 .²² In earlier years the ore has been used in the manufacture of refractories.

Belgium.—The Soc. d'Affinage de Nickel S. A. at Duffel near Antwerp began operations early in 1939 to refine imported ores, particularly nickel, chrome, and copper.²³

Brazil.—Brazil is stated²⁴ to be the largest exporter of chromite in South America. Five known deposits have been described.²⁵

Exports in recent years have been as follows: 1937, 850 tons; 1938, 900 tons; 1939, 3,500 tons; 1940, 4,600 tons; 1941, 4,400 tons.

Canada.—Canadian chromite production in the last 3 years has been as follows: 1942, 11,456 short tons worth \$343,568; 1943, 29,595 tons worth \$919,878;²⁶ and 1944, 27,720 tons worth \$761,229.²⁷

The report for 1943²⁸ states that 15 firms engaged in mining or developing chromite in 1943 and gives a list (pp. 31-32) of firms that have engaged in mining this ore.

Canadian consumption²⁹ in 1943 was 131,267 tons, an increase of 29 percent over that of 1942. Forty-eight percent of the total imports of nearly 112,210 tons came from Africa, mainly from Rhodesia; 29 percent from India; and 23 percent from the United States, mainly from Montana. Production of ferrochrome and other chrome addition agents in 1943 was about 47,000 short tons, an increase of 40 percent over that of 1942.

* Mining Journal (London), vol. 222, No. 5658, Jan. 29, 1944, p. 70.

† Metal Bulletin (London), No. 2916, Aug. 4, 1944, p. 11.

‡ Mining Journal (London), vol. 222, No. 5686, Aug. 12, 1944, p. 493.

§ Foreign Commerce Weekly, vol. 18, No. 5, Jan. 27, 1945, p. 16.

|| Mining Journal (London), Chromite Production in Queensland: Vol. 223, No. 5699, Nov. 11, 1944, p. 690.

¶ Industrial Australian and Mining Standard, vol. 99, No. 2542, Sept. 1, 1944, p. 191.

‡ Work cited in footnote 20.

§ Metal Bulletin (London), No. 2926, Sept. 12, 1944, p. 4.

¶ Foreign Commerce Weekly, vol. 17, No. 3, Oct. 14, 1944, p. 41.

|| Chemical and Metallurgical Engineering, vol. 51, No. 9, September 1944, p. 205, quoting a digest from Brazil 1942, Mineral Resources, Bull. 56, 1943, p. 30, published in Brazil.

‡ Department of Trade and Commerce, Dominion Bureau of Statistics, Census of Industry, Mining Metallurgical and Chemical Branch, Report on Miscellaneous Metals in Canada, 1943, p. 10.

¶ Work cited in footnote 25, 1945, pp. 2-3, Canada's Mineral Production for the Calendar Year 1944.

§ Preliminary figure, subject to revision.

|| Work cited in footnote 26.

¶ Work cited in footnote 26.

With the withdrawal of Government support,³⁰ a number of properties producing strategic metals that were unable to operate profitably at world prices, closed down. Among these is Chromeraïne in the Black Lake area.

During the year the operations of the Chromium Mining & Smelting Corp., Ltd., were at about 50 percent of capacity.^{31 32} Sales of Chrom-X (an exothermic mixture containing chromium oxide) in the United States were below the levels hoped for.

During 1943 Chromite, Ltd., had a good year,³³ improving its financial position, mining 50,600 tons of ore, and milling 2,000 tons from the dump. Concentrates produced amounted to 14,540 tons. A new shaft has been sunk.

During 1943 Manitoba Chromium, Ltd., a subsidiary of the Hudson Bay Mining & Smelting Co., Ltd.,³⁴ was formed to take over the Page chrome property in the Bird River area of Manitoba. An 85-ton shipment³⁵ was made to Ottawa for testing purposes. Further work is being done.

C. H. Stockwell³⁶ has published an exhaustive account of the chromite deposits of the Eastern Townships of Quebec.

China.—Although molybdenum and tungsten are found in China, no discovery of chromium³⁷ has been reported.

Colombia.—A small company (Industrial de Cromo Limitada) has been formed in Medellin for the treatment of locally mined chrome ore.³⁸

Cuba.—The mining of refractory chromite in 1944 was restricted to 50 percent of the 1943 figure because of large stock piles in Cuba. Exports to the United States exceeded production by 72 percent and were 6 percent larger than in 1943. The known supply in the two producing areas—Camaguey and Punta Gorda—are adequate to meet any likely export demand in 1945.

Because of an increased demand for lump metallurgical chromite of good grade, mining was renewed in the Mayari district, and the output of the principal producer more than doubled.³⁹

During the year considerable drilling, trenching, and stripping were done with a view to extending the known reserves. At least two new properties—Don Ismael and Narcisco—were opened, but it is understood that the latter was mined out some time in the summer.

Cuban production and exports of chromite in 1944, in short tons

	Production	Exports	Stocks Dec. 31, 1944
Refractory grade	191,000	330,000	142,000
Metallurgical grade.....	21,000	21,000	12,000
	212,000	351,000	154,000

³⁰ Metal Bulletin (London), No. 2943, Nov. 10, 1944, p. 5.

³¹ Metal Bulletin (London), No. 2869, Feb. 15, 1944, p. 7.

³² Metal Bulletin (London), No. 2942, Nov. 7, 1944, p. 10.

³³ Northern Miner, Record Good Year for Chromite Ltd.: Vol. 29, No. 50, Mar. 2, 1944, pp. 17 and 19.

³⁴ Metal Bulletin (London), No. 2892, May 9, 1944, p. 12.

³⁵ Canadian Mining and Metallurgical Bulletin, No. 385, May 1944, p. 253.

³⁶ Stockwell, C. H., Chromite Deposits of the Eastern Townships, Quebec: Canadian Min. and Met. Bull., No. 382, February 1944, pp. 71-86.

³⁷ Metal Bulletin (London), Minerals in China's Industrialization—Adequate Resources for Requirements: No. 2901, June 13, 1944, p. 5.

³⁸ Caputi, Michael, Consular Report 140, Medellin, Colombia, Feb. 11, 1944. (Not restricted.)

³⁹ Nufer, Albert F., and Botsford, C. A., Consular Report 74, American Embassy, Habana, Cuba, Feb. 19, 1945: Econ. Rev. for 1944, p. 17. (Unrestricted.)

Egypt.—Licenses to prospect for chromite have been issued to the Société Misr des Mines et Carrières and to Rene Kattawi of Cairo.⁴⁰

Germany.—In view of the complete absence of deposits of chromite in Germany proper, the loss of foreign sources of supply has been a staggering blow to German industry. As recorded in the Minerals Yearbook, the imports by Germany in the immediate prewar years were: 1935, 95,440 metric tons; 1936, 123,375 tons; 1937, 132,162 tons; 1938, 176,406 tons, and in the first 7 months of 1939, 136,434 tons, as compared with 78,948 tons in the corresponding months of the previous year. In 1943 Turkey is reported⁴¹ to have shipped 47,000 tons to Germany and in the first 2 months of 1944, 15,000 tons before termination of the Clodius Agreement. Another source⁴² estimates the 1943 shipments to Germany from Turkey at 30,000 tons. Shipments to Germany from all other foreign sources were subsequently cut off^{43 44 45} as a result of interruption of all rail traffic from the Balkans. It is also reported that Spanish production, substantially all of which went to Germany, increased from 500 tons in 1941 to about 4,000 tons in 1943. The relation of the Balkan sources of chrome to Germany will be described in the section on Yugoslavia.

A German broadcast monitored in England⁴⁶ mentioned that the Dr. Alexander Wacker Ges. für elektrochemische Industrie, G. m. b. H., of Munich had to reduce its ferrochrome operations owing to a shortage of chrome ore.

An excellent study of enemy (German and Japanese) ordnance materials has been published by the Battelle Memorial Institute.⁴⁷

Greece.—Early in 1944 Lord Selborne (British), Minister of Economic Warfare, stated that the Greek and Yugoslav forces had inflicted "most serious damage" on the chrome mines in those countries.⁴⁸ Greek production in 1943⁴⁹ was only 30,000 tons as against an expected 45,000 tons.

*India.*⁵⁰—The bulk of the Indian production comes from the Hassan and Mysore districts. The first discovery of this ore was made in the latter region in 1905, and mining was begun in 1907. Some of the ore contains less than 42 percent Cr_2O_3 , but there are lenses of 47- to 52-percent material. The high-grade deposits amount to about 90,000 tons. The Byrapur deposits contain a few thick lenses of over 48-percent ore. In the Mysore district the ore occurs in veins and lenses in serpentinized ultrabasic rocks. The best and largest deposits are at the Sinduvalli mine and have been worked by underground methods. These deposits have produced about 136,000 tons of ore running from 48- to 52-percent content. Further west there are deposits of 40- to 44-percent Cr_2O_3 ore. Other deposits of 30-percent ore are known (some of which can be beneficiated) but are not being mined. Chromite also occurs in Baluchistan. In 1938⁵¹ the output was 44,149 tons, of which 18,214 tons were exported. The sole previous use for

* Tuck, S. Pinkney, Egyptian Production of Certain Minerals: Consular Report 102, Cairo, July 24, 1944. (Not restricted.)

⁴⁰ Steel, The Loss of Turkish Ore Jolts the Nazi War Machine: Vol. 115, No. 15, Oct. 9, 1944, p. 119.

⁴¹ South African Mining and Engineering Journal, vol. 55, pt. 1, No. 2679, June 10, 1944, p. 335.

⁴² Mining Journal (London), vol. 222, No. 5694, Oct. 7, 1944, p. 619.

⁴³ Daily Metal Reporter, vol. 44, No. 193, Oct. 4, 1944, pp. 1 and 3.

⁴⁴ Mining Journal (London), vol. 222, No. 5669, Apr. 15, 1944, p. 224.

⁴⁵ Metal Bulletin (London), No. 2928, Sept. 19, 1944, p. 16.

⁴⁶ Cady, J. R., Gillet, H. W., and Grenell, L. H. (Battelle Memorial Institute), Enemy Matériel from the Metallurgical Point of View: Metal Prog., vol. 47, No. 2, February 1945, pp. 289-320.

⁴⁷ Metal Bulletin (London), No. 2865, Feb. 1, 1944, p. 15.

⁴⁸ Metal Bulletin (London), No. 2884, Apr. 7, 1944, p. 7.

⁴⁹ Mining Journal (London), Mineral Deposits in Mysore: Vol. 222, No. 5671, Apr. 29, 1944, p. 248.

⁵⁰ Metal Bulletin (London), India's Mineral Industry: No. 2910, July 14, 1944, pp. 4-5, and 10.

the domestic consumption was for refractories. In 1944 ⁵² there was some production of dichromates.

Japan.—The large new chrome discovery reported in the 1943 Minerals Yearbook ⁵³—in the Sarugun district—is to be exploited by the Teikoku Manganese Mining Co.⁵⁴

New Caledonia.—Arrangements have been made to refinance the Chagrin Chrome Mines, Ltd.;⁵⁵ under the new arrangement, it is expected that shipments of ore to America can be made.

Palestine.—Early in 1943 chrome ore was reclassified as a separate import item exempt from import duty.⁵⁶ It had previously been scheduled in the class with "metalliferous ores and scrap not elsewhere specified," which carried a 15-percent ad valorem duty.

Philippine Islands.—A recent estimate ⁵⁷ of chromite in the Philippine Islands places the reserves of refractory-grade ore at the Masinloc mine at 10,000,000 tons, a figure that agrees closely with that quoted in the 1941 Minerals Yearbook.⁵⁸ This mine is worked by open-pit methods. At the Acoje property, in the Zambales Mountains north of Bataan, 250,000 tons of high-grade metallurgical ore are estimated to be present, plus a tonnage of low-grade ore which might be beneficiated. The Japanese are reported to have exploited the Acoje and Filipinas mines for high-grade ore but to have done nothing at Masinloc.

Portuguese East Africa.—Exports of chromite from Beira to the United States in 1944 were approximately 180,000 tons as compared with 245,000 tons in 1943.

In December the shipments were classified as 23,000 long tons of metallurgical ore and 800 tons of refractory-grade.

Rumania.—It has been reported that in 1942 the first production of chrome ore since World War I was made, amounting to 500 tons.⁵⁹ Rumanian chromite reserves have been variously reported at 1 million to 10 million tons. Evidence at hand favors the lower figure. The Germans are said to have produced 40,000 tons of ore from the Temesvar mine in 1917.

Southern Rhodesia.—The mining industry in Southern Rhodesia is subject to heavy taxation ⁶⁰ but some relief is offered to small producers where actual production can be shown. The difficult shipping situation from all South African ports has been noted elsewhere in this chapter. The paucity of published information on Southern Rhodesia is in part explained by a quotation from the 1943 edition of the Rhodesian Mining Year Book: "The publication of statistics concerning mineral production—has been discontinued in the interests of the Allied war effort."⁶¹ It is evident that the technical and trade press has been guided by the same principles.

⁵² Mining Journal (London), India's Metal Industries: Vol. 223, No. 5703, Dec. 9, 1944, p. 758.

⁵³ Foreign Commerce Weekly, vol. 13, No. 8, Nov. 20, 1943, p. 27.

⁵⁴ Foreign Commerce Weekly, vol. 16, No. 10, Sept. 2, 1944, p. 35.

⁵⁵ Industrial Australian and Mining Standard, vol. 100, No. 2551, Feb. 1, 1945, p. 327.

⁵⁶ Palestine Gazette of May 20, 1943, as quoted by the Bureau of Foreign and Domestic Commerce, Foreign Tariffs and Trade Controls, Survey of Changes Reported to the Division of International Economy During Week Ending June 21, 1943, p. 8.

⁵⁷ Bain, H. Foster, The Philippine Mineral Industry in the Postwar Period: Min. Mag. (London), vol. 72, No. 1, Jan. 1945, p. 13.

⁵⁸ Frasché, D. F., Chromite Deposits of the Philippine Islands (abs.): Econ. Geol., vol. 36, 1941, pp. 845-846.

⁵⁹ Economist (London), Roumanian Anxieties: Vol. 145, No. 5230, Nov. 20, 1943, pp. 679-680.

⁶⁰ Davenport, G. A., Mine Taxation in Southern Rhodesia: South African Min. and Eng. Jour., vol. 54, pt. 2, No. 2659, Jan. 22, 1944, pp. 473-475.

⁶¹ American Consulate General, Johannesburg, South Africa, Consular Report 20, May 4, 1943.

Spain.—On November 13, 1944, an order was published reserving provisionally in favor of the State the chrome- and nickel-ore deposits in the Province of Málaga.⁶²

Sweden.—Late in 1944 and early in 1945 there was interest in the purchase of a small tonnage of chrome concentrates in Turkey for Swedish account. Minerals Yearbooks, 1935–38, state that Sweden is normally a purchaser of chromite and that in the period 1934–38 the yearly importations ranged between 35,000 and 72,000 metric tons.

Turkey.—A new chromite deposit has been found near Dindarzik in the neighborhood of Bigaditsch,⁶³ and another discovery is reported⁶⁴ as having been made in Southeastern Anatolia, but no more definite location is given. This latter deposit is stated to be considerably richer than those hitherto known in Anatolia. Turkish exports of chromite since 1938 have been estimated⁶⁵ as follows: 1938, 208,055 metric tons; 1939, 192,842; 1940, 110,037; 1941, 81,286; 1942, 129,307; 1943, 103,000. A large part of the Turkish deliveries to Germany was made in German-owned rolling stock, which was loaned to the Turks for this purpose.⁶⁶ A reasonable estimate of the 1944 Turkish production would slightly exceed 150,000 tons. The Guleman group of mines has been the largest and most important producer of high-grade metallurgical lump ore. The production of this group in the last 9 years has been as follows: 1936, 23,000 metric tons; 1937, 49,000; 1938, 95,000; 1939, 105,000; 1940, 92,000; 1941, 64,000; 1942, 31,000; 1943, 60,000; 1944, 67,000. An estimate of an additional 250,000 tons of low-grade ore during the same period is a reasonable one. The indicated reserve of metallurgical ore in the Guleman group is 500,000 tons, and there are indications that farther east and north there may be 1,000,000 tons more. In addition to the Guleman production, concentrates are being produced at Fethiye and also at Ces by the Tekirova Co.

U. S. S. R.—According to an article in Pravda,⁶⁷ production in the Urals has trebled since the war began. At Nizhny Tagil the expansion has been of this order of magnitude, and this heavy metallurgical center has become the Red Army's chief arsenal and workshop since the Germans overran the Ukraine, Krivoi Rog, and the Donetz Basin. The Ural Range is 2,500 miles long and is rich in iron, copper, nickel, chrome, manganese, and other important ores. Exports of chromite from the U. S. S. R. to the United States in the first half of 1944 were at the rate of 100,000 long tons a year.

Union of South Africa.—Chromite production of the Union of South Africa for the years 1941–43 was as follows: ⁶⁸ 1941, 226,886 short tons, averaging 45.83 percent Cr₂O₃; 1942, 293,386 tons averaging 45.09 percent; 1943, 108,973 tons averaging 45.20 percent.

A number of heavy chrome chemicals are being made in South Africa,⁶⁹ among them bichromates, chrome tanning salts, and chromate pigments. A satisfactory standard of quality has been attained. The South African Government hopes that this industry will be maintained after the war.

⁶² Hurdlebring, August, Consular Report 232, American Embassy, Madrid, Nov. 22, 1944, quoting Order of Nov. 7, 1944. (Not restricted.)

⁶³ Metal Bulletin (London), No. 2884, Apr. 7, 1944, pp. 7–8.

⁶⁴ Mining Journal (London), vol. 222, No. 5676, June 3, 1944, p. 324.

⁶⁵ Mining Journal (London), vol. 222, No. 5672, May 6, 1944, p. 265.

⁶⁶ Iron and Coal Trades Review, vol. 148, No. 3972, Apr. 14, 1944, p. 578.

⁶⁷ Quoted in Metal Bulletin (London), No. 2760, Jan. 15, 1943, pp. 4–5.

⁶⁸ Benson, Barry T., Consular Report 130, Johannesburg, South Africa, Aug. 2, 1944. (Not restricted.)

⁶⁹ Chemistry and Industry, Chemistry and Industry in South Africa: No. 34, Aug. 19, 1944, p. 302.

Venezuela.—The occurrence of chromite deposits in the basic igneous rocks of Cerro Santa Ana on the Paraguana Peninsula has been known for many years. These were thoroughly investigated a few years ago but were found to be noncommercial.⁷⁰

Yugoslavia, Bulgaria, and Macedonia.—The latest chromite-production figures ⁷¹ for Yugoslavia are 58,470 tons in 1938; 43,007 in 1939; and 71,019 in 1940. Bulgaria produced ⁷² 2,350 tons in 1937, and it is thought that the production amounted to 3,000 tons in 1940. Reserves are estimated at 50,000 tons. After the acquisition of Greek Macedonia by Bulgaria, the region became the second producing area in Europe, being exceeded only by U. S. S. R.

⁷⁰ Consular Report 198, Mineral Trade Notes on Venezuela for the Quarter Ended Sept. 30, 1944, American Embassy, Caracas, Venezuela, Nov. 24, 1944.

⁷¹ South African Mining and Engineering Journal, Balkan Chrome Ore: Vol. 54, No. 2658, pt. 2, Jan. 15, 1944, p. 461.

⁷² Work cited in footnote 69.

NICKEL

By HUBERT W. DAVIS

SUMMARY OUTLINE

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SUMMARY

Nickel not only continued to be a critical war material in 1944, but its supply was the least abundant of the ferrous-alloying metals. However, notwithstanding that the supply available to the United States was less than in 1943, it was adequate to meet all war demands. Consumption of primary nickel in the United States was about 4 percent less than in 1943. Proportionately less nickel was used in steel mills in 1944 than in 1943, but this decline was offset in part by increases in consumption of nickel in nonferrous alloys and other products. The continued use of NE (national emergency) steels and the recovery of nickel scrap resulted in a substantial saving in nickel in 1944.

Salient statistics for nickel, 1940-44

	1940	1941	1942	1943	1944
United States:					
Production:					
Primary.....short tons..	554	660	612	642	988
Secondary.....do.....	4,152	5,315	4,142	6,917	(1)
Imports (gross weight) 2.....do.....	92,468	124,130	132,954	141,249	134,932
Exports (gross weight) 3.....do.....	11,994	7,125	7,096	9,464	7,931
Price per pound 4.....cents..	35	35	35	35	35
Canada:					
Production.....short tons..	122,779	141,129	142,606	144,009	137,607
Imports.....do.....	594	1,011	499	545	(1)
Exports.....do.....	124,516	137,595	138,795	135,547	(1)
World production (approximate).....do.....	154,000	179,000	182,000	183,000	179,000

1 Figures not yet available.

2 Excludes "All other manufactures of nickel"; weight not recorded.

3 Excludes "Manufactures"; weight not recorded.

4 Price quoted by International Nickel Co. of Canada, Ltd., for electrolytic nickel at New York, in 2-ton minimum lots.

Imports of nickel in all forms were about 3 percent less than in 1943, which, however, was a record year. Smaller receipts from Canada were partly offset by supplies of oxide from Cuba (a new producer) and increased imports from New Caledonia.

Output of nickel in Canada in 1944 was 4 percent less than the all-time high of 1943 owing to the continued labor shortage and to the use of much inexperienced labor.

As heretofore, the domestic output of primary nickel was insignificant in 1944.

The St. Louis Smelting & Refining Co. began producing nickel commercially at its property near Fredericktown, Madison County, Mo., in July 1944. The complex ore is treated in a flotation mill, which yields a lead concentrate, a copper concentrate containing some lead, and a nickel-cobalt concentrate.

POSTWAR OUTLOOK

The postwar demand for nickel has been ably discussed in the *Engineering and Mining Journal*,¹ and the article is quoted in full in the chapter of this series for 1943.

Although data on reserves of nickel ore have not been nearly as complete since the beginning of World War II, there is enough information to give assurance of ample nickel supplies for some years to come. Fortunately for the United States, the largest high-grade reserves are situated nearby in Canada, where 85 percent of the world supply has originated in recent years. Developments elsewhere probably will supplement the Canadian supply to such an extent as to reduce the proportion of the world nickel produced in Canada in the postwar period. The USSR, by its acquisition of the Petsamo nickel mine, probably will be an important factor in future nickel production, and undoubtedly it will displace New Caledonia as the second largest producing country. Despite the war in the Pacific, New Caledonia has continued to produce nickel, although at a reduced rate because of labor and supply difficulties. After the war, New Caledonia almost certainly will again produce nickel at its prewar rate. According to Nicaro Nickel Co., the future of Cuba—where production of nickel began late in 1943—as a profitable peacetime producer will depend on several factors that cannot be fully appraised at this time. Venezuela may become a future producer of nickel. That country is reported to have large reserves of relatively high-grade nickel ore, favorably situated with regard to transportation and susceptible to cheap strip mining. The International Nickel Co. of Canada, Ltd., has an option on the Loma de Hierro deposit and is investigating its potentialities. Brazil, about which great hopes of becoming a substantial producing country were entertained, will not be a factor in the immediate postwar production period, because of remoteness of the deposits and excessive costs of power, fuel, and freight. Extensive exploration and development of reported deposits of nickel in the United States by the Bureau of Mines and private companies during the war period have not resulted in the discovery of ore bodies large or rich enough to sustain a significant domestic nickel-mining industry.

Since 1929 the base price of electrolytic nickel has been at 35 cents a pound, despite the rise in production costs. The constancy of price has been possible because one Canadian company has held a dominating position as a producer. The stable price, however, has been an important factor in developing a world market for nickel. Although Canada probably will supply less of the world production of nickel than in the past, it is believed that its dominant position will have a stabilizing effect on the world price, which is not expected to change much, if any.

PRODUCTION

Domestic production of nickel is small and comprises metals recovered from scrap-nickel anodes, nickel silver, and copper-nickel alloys (including Monel metal), and primary metal recovered in copper refining and produced from ore and as a byproduct of talc production, as listed in the following table. Domestic primary nickel

¹ *Engineering and Mining Journal*, Metals for the Alloy Steels: Vol. 145, No. 2, February 1944, p. 84.

was recovered in 1944 as a byproduct in copper refining at Baltimore, Md., Carteret, N. J., Laurel Hill, N. Y., Perth Amboy, N. J., and Tacoma, Wash. Although all the nickel recovered as a byproduct of copper refining is credited to domestic production, it appears that some of the blister copper richest in nickel is that imported into the United States for refining. Roasted nickel-cobalt concentrate containing about 19 percent nickel and 12 percent cobalt was produced at Fredericktown, Mo., in 1944. Concentrates containing 10 percent nickel and 0.7 percent cobalt were recovered as a byproduct of talc production in Vermont; however, none was shipped.

Nickel produced in the United States, 1940-44

Year	Primary (short tons) ¹		Secondary ²	
	Byproduct in copper refining ³	Other ⁴	Short tons	Value
1940	554		4,152	\$2,906,400
1941	619	41	5,315	3,720,500
1942	612		4,142	2,899,400
1943	642		6,917	4,841,900
1944	⁵ 988	(⁵)	(⁵)	(⁵)

¹ Bureau of Mines not at liberty to publish value.

² Nickel recovered as metal and in alloys and salts.

³ Nickel content of nickel salts and metallic nickel.

⁴ Nickel content of concentrates and matte produced from ore and of concentrates produced as byproduct of talc.

⁵ Production from "Other" included under "Byproduct in copper refining." Bureau of Mines not at liberty to publish figures.

⁶ Figures not yet available; they will be found in chapter on Secondary Metals—Nonferrous.

FOREIGN TRADE ²

The nickel imported into the United States in 1944 was 3 percent less than in 1943, which however was a record year. Imports comprised chiefly metallic nickel, matte, and oxide. As heretofore, Canada was the chief source of the imports; it supplied 183,868,941 pounds of metallic nickel, 53,452,748 pounds of Monel matte (averaging 53 to 54 percent nickel and 25 percent copper), 1,198,009 pounds of roasted matte (averaging 75 percent nickel), and 3,220,615 pounds of oxide. The roasted matte and virtually all the oxide were refined to nickel, and the Monel matte was refined to Monel metal and other products at the plant of the International Nickel Co., Inc., Huntington, W. Va. About 2,100 short tons of nickel were produced at Huntington from Canadian roasted matte and oxide in 1944. During the year 670,187 pounds of electrolytic nickel were received from French Morocco; this metal originated from ore mined and refined in Canada. New Caledonia supplied 18,121,982 pounds of matte that contained 77 to 78 percent nickel; it was shipped to Huntington for refining. About 5,700 short tons of nickel were produced from New Caledonia matte in 1944. Cuba furnished 7,680,367 pounds of oxide, a relatively small amount of which was refined at Wilmington, Del. Cuba also supplied 7 pounds of ore. Venezuela supplied 56,000 pounds of ore, which was reshipped to Canada. The United Kingdom

² Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

furnished 1,566,039 pounds of metallic nickel and 28,030 pounds of oxide. Switzerland supplied 68 pounds of metallic nickel.

The nickel content of the unmanufactured nickel products imported into the United States is estimated at 236,586,000 pounds in 1944, compared with 244,983,000 pounds in 1943.

Exports of nickel comprise largely products manufactured from imported raw materials. Exports of alloys (including Monel metal) and scrap were 29 percent less in 1944 than in 1943, but exports of metallic nickel were 1 percent more. Exports of nickel salts and compounds were almost double those of 1943. The USSR (7,266,647 pounds), United Kingdom (6,665,963 pounds), and Canada (852,613 pounds) were the chief markets for nickel, Monel metal, alloys, and scrap in 1944.

Nickel (excluding residues) imported for consumption in the United States, 1942-44, by classes

Class	1942		1943		1944	
	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured:						
Nickel ore and matte.....	80,378,120	\$11,934,409	86,971,459	\$13,017,158	72,828,746	\$11,713,123
Nickel pigs, ingots, shot, etc.....	161,202,200	40,588,948	184,042,404	46,272,805	186,104,935	48,144,356
Nickel bars, rods, tubes, etc.....	372,930	174,511	1,115,040	352,619	300	598
Nickel oxide.....	23,954,909	3,982,877	10,368,220	1,842,114	10,929,012	2,079,897
Manufactured:						
Nickel silver or German silver in sheets, strips, rods, and wire.....			1,017	273	291	198
All other manufactures of nickel.....	(1)	57,478	(1)	1,493	(1)	551,530
		56,738,223		61,486,462		62,489,702

¹ Quantity not recorded.

Nickel exported from the United States, 1942-44, by classes

Class	1942		1943		1944	
	Pounds	Value	Pounds	Value	Pounds	Value
Ore, concentrates, and matte...	104	\$92	145,090	\$86,762	1,521	\$1,005
Alloys and scrap containing nickel (including Monel metal).....	8,996,413	3,472,575	11,266,777	3,898,669	8,041,351	2,315,944
Metal in ingots, bars, sheets, etc.....	4,251,948	1,947,597	6,559,228	3,006,809	6,892,221	3,011,097
Manufactures.....	(1)	420,294	(1)	1,029,966	(1)	2,522,168
Nickel-chrome electric resistance wire.....	668,194	792,255	508,059	846,221	477,476	793,052
Nickel silver or German silver, crude, scrap, or bars, rods, etc.....	155,282	94,563	182,625	127,588	104,539	56,287
Nickel salts and compounds...	119,971	46,417	176,820	67,676	345,682	124,651
		6,773,793		9,063,691		8,824,204

¹ Quantity not recorded.

WORLD PRODUCTION

Because of restriction on the publication of statistics by many governments, few production figures have become available since 1939.

World production of nickel (content of ore), 1937-44, by countries, in metric tons¹

[Compiled by B. B. Waldbauer]

Country ²	1937	1938	1939	1940	1941	1942	1943	1944
Australia		20		(3)	(3)	(3)	(3)	(3)
Belgium	104	375	25	(2)	(2)	(2)	(2)	(2)
Canada	1,233	959	921	(2)	(2)	(2)	(2)	(2)
France	102,015	95,514	102,559	111,383	128,029	129,369	130,642	124,834
Germany							2,430	4,679
Greece	14	33	(3)	(3)	(3)	(3)	(3)	(3)
Italy	890	550	(2)	(2)	(2)	(2)	(2)	(2)
Japan	957	1,207	1,336	(2)	(2)	(2)	(2)	(2)
Netherlands				21	9	7	(2)	(2)
Norway	68	150	100	(3)	(3)	(3)	(3)	(3)
Sweden	132	163	(2)	(2)	(2)	(2)	(2)	(2)
Switzerland		500	753	2,222	(2)	(2)	(2)	(2)
United Kingdom								
United States	11,600	11,700	10,625	10,535	10,395	9,415	5,408	6,371
Yugoslavia	877	1,245	1,106	950	822	(2)	633	(2)
Other countries	4	76	490	(2)	(2)	(2)	(2)	(2)
Total	2,000	2,500	(3)	8,650	375	358	899	(2)
By-product in electrolytic refining of copper	199	377	357	503	599	555	582	896
Total	120,100	115,500	122,000	140,000	162,000	165,000	166,000	162,000

¹ In addition to countries listed Finland, Japan, and Sweden produce nickel, but data of output are not available.

² Data not yet available; estimate included in total.

³ Excludes small quantity produced in British Columbia.

⁴ Fiscal year ending Mar. 20 of year stated.

⁵ Estimate.

⁶ Imports into United States.

⁷ By-product in electrolytic refining of copper. In 1941 includes also production from ore and as by-product of talc; in 1944 includes also production from ore.

Brazil.—The American Smelting & Refining Co., which had an interest in the Tocantins nickel deposit in the State of Goiaz, abandoned the project in 1944. According to the company:³

It presented a difficult metallurgical problem, but this had been solved in our research laboratory in Perth Amboy. Later, however, it was found that the process, as applied to actual Brazilian conditions, would not permit of profit. The mine has a large body of ore containing nickel in an amount that, using our process, would in more favorable localities yield a suitable profit. But the pioneer conditions due to geographical remoteness of the mine, the scarcity of labor, which would have to be imported from distant localities, and the excessive cost of power, fuel and freight, were factors whose combined effect, as finally proven, could not be successfully overcome. The Company, accordingly abandoned the project and surrendered its shares for the benefit of the Brazilian stockholders.

The nickel deposits in the State of Goiaz have been described by Pecora,⁴ who concludes as follows:

The nickel-silicate deposits near São José do Tocantins, Goiaz, Brazil, are the most promising nickel-silicate deposits that have thus far been reported in the Western Hemisphere. Most of the earlier published estimates, however, of potential reserves and tenor appear too optimistic. * * * Decisions as to metallurgical process and product to be marketed will have to be made before the cut-off grade can be established, and the potential value of the deposits determined. Roads and bridges must be repaired and constructed, sources of hydro-electric power on the upper Tocantins River must be investigated, supplies of flux and fuel must be assured, and additional prospecting must be done before a local industry can be established. The ore reserves, in the opinion of the writer, do warrant the establishment of a local industry. During the critical years of the war, high-grade ore can easily be selected for shipment, and meanwhile additional development can outline new deposits of high-grade ore. Surface mining of nickel-silicate and cobalt "pebble" ore could be begun immediately, by local laborers using hand tools; and trucks could set out a day later for the railroad at Anapolis, loaded with "pebbles" of nickel-cobalt-manganese oxide or with high-grade nickel-silicate ore.

Canada.—Virtually all the Canadian output is derived from copper-nickel ores of the Sudbury district, Ontario. Some nickel is also

³ American Smelting & Refining Co., 46th Annual Report: 1944, pp. 2-3.

⁴ Pecora, W. T., Nickel-Silicate and Associated Nickel-Cobalt-Manganese-Oxide Deposits near São José do Tocantins, Goiaz, Brazil: U. S. Geol. Survey Bull. 935-E, 1944, 305 pp.

recovered as a byproduct from silver-cobalt ores of Cobalt and other areas in northern Ontario. Two companies—International Nickel Co. of Canada, Ltd., and Falconbridge Nickel Mines, Ltd.—are the principal producers. Nickel production in Canada was 137,607 short tons in 1944, compared with 144,009 tons in 1943.

Sales of nickel in all forms by the International Nickel Co. of Canada, Ltd., derived from its own mine production, was 250,212,561 pounds, a decrease of 15,176,762 pounds from 1943.⁵ Company sales, together with the volume refined for others, totaled 285,238,333 pounds in 1944.

Chiefly as a result of increased mechanization to overcome labor shortage and to improved metallurgy, Falconbridge Nickel Mines, Ltd.,⁶ made the largest production of nickel in its history in 1944. Ore treated in 1944 totaled 830,254 short tons (807,048 tons in 1943) and comprised 475,974 tons of milling ore and 354,280 tons of smelting ore. The ore treated averaged 1.59 percent nickel in 1944 (1.62 percent in 1943). Matte produced in 1944 contained 12,049 tons of nickel (11,597 tons in 1943). Ore reserves were 12,669,500 tons averaging 1.72 percent nickel on December 31, 1944.

A relatively small amount of copper-nickel ore from outlying nickel properties was again shipped to the International Nickel Co. of Canada, Ltd.

Cuba.—Mechanical difficulties incident to efficient operation of the new nickel plant of Nicaro Nickel Co. at Lengua de Pajaro were overcome during 1944, and steady progress was made toward the goal of full production. Imports of nickel oxide from Cuba were 7,680,367 pounds in 1944, some of which was refined at Wilmington, Del. According to the Freeport Sulphur Co., of which the Nicaro Nickel Co. is a subsidiary:⁷

During 1944, steady progress was made in increasing the output and the plant is now producing nickel oxide at the rate of nearly 2,000,000 pounds (contained metal) per month. Capacity operation is scheduled to be reached within the next six months. The results of this first year of production have demonstrated the practicability of the Nicaro process for extracting nickel from low-grade ores and have established Nicaro as a new source of nickel for the United States. Whether Nicaro can be made a profitable commercial venture for peacetime depends on several factors the effect of which cannot be predicted at this time. For the time being, Nicaro Nickel Company's income from the project is limited to a small fee which it receives under its contract with Metals Reserve Co.

U. S. S. R.—By the terms of the armistice agreement entered into between the U. S. S. R. and Finland on September 19, 1944, territory including the Petsamo district was ceded by Finland to the Soviet Government, and the ownership of the nickel mines and installations passed to that Government. In a protocol to the armistice agreement, signed in Moscow on October 8, the Soviet Government has undertaken to pay \$20,000,000 in equal annual installments during the ensuing 6 years as full and final compensation to the International Nickel Co. of Canada, Ltd., and its subsidiary, the Mond Nickel Co., Ltd.

Venezuela.—The International Nickel Co. of Canada, Ltd., is reported to have taken an option on a nickel-silicate deposit near Loma de Hierro, and pitting and drilling operations have been in progress to determine its potentialities. A small quantity of ore was shipped to Canada in 1944.

⁵ International Nickel Co. of Canada, Ltd., Annual Report: 1944, p. 4.

⁶ Falconbridge Nickel Mines, Ltd., 16th Annual Report: 1944, pp. 1-11.

⁷ Freeport Sulphur Co., 32d Annual Report: 1944, pp. 5-6.

COBALT

By HUBERT W. DAVIS

SUMMARY OUTLINE

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SUMMARY

The United Nations did not lack supplies of cobalt in 1944. Indeed, with the output of Finland available, the United Nations control virtually the entire world cobalt supply, except that of Burma. On the other hand, with Germany's loss of cobalt production from French Morocco in 1943 and Finland in 1944, its remaining current source of supply was limited to a small domestic output. Presumably, Japan was in a more favorable position than Germany with respect to cobalt because of a small domestic output and the Burmese production. However, Burmese speiss, which is obtained by smelting lead ore, is difficult to refine.

In the United States, despite the fact that cobalt was free from allocation and that imports were 32 percent less than in 1943, available supplies were more than adequate for requirements in 1944. Because of the favorable supply position it was not necessary to process available stocks of French Moroccan ore. Notwithstanding production from the newly opened property at Fredericktown, Mo., domestic output of cobalt was only 13 percent greater than in 1943.

Consumption of cobalt ore, alloy, concentrate, and speiss by refiners or processors was about 1 percent more than in 1943, but consumption of cobalt products by industrial consumers was about 5 percent greater.

Maximum prices for cobalt metal, fines, powder, oxides, and other alloys and compounds established by the Office of Price Administration on November 2, 1943, continued in effect in 1944. The maximum price for metal containing 97 percent cobalt was fixed at \$1.50 to \$1.57 a pound on contract and \$1.60 to \$1.67 on spot sales. The maximum prices for other cobalt products were the highest charged by a seller on a delivery made during January, February, or March 1942. Cobalt ores, concentrates, and crudes are exempt from the provisions of the price regulation.

Purification of cobalt precipitates containing iron and other impurities is the subject of United States patent 2,367,239. According to this patent, which is assigned to the International Nickel Co., Inc.:

The present invention relates to the purification of cobalt precipitates containing iron, cobalt, nickel and other impurities, and more particularly to the purification and recovery of high grade cobalt from precipitates obtained in the purification of electrolytes employed in the electrolytic refining of nickel. Such precipitates contain not only cobalt, but also copper, iron, arsenic, lead and nickel.

A relatively simple method of recovering cobalt from cobaltite and danaite has been devised by Forward.¹

MINE PRODUCTION AND DEVELOPMENT

Production of cobalt ore in the United States was 13 percent greater in 1944 than in 1943, but shipments were 27 percent less. The Bethlehem Steel Co., Bethlehem, Pa., was again the chief producer, but during the last quarter of 1944 it was exceeded by the St. Louis Smelting & Refining Co., Fredericktown, Mo.

Production by the Bethlehem Steel Co. was 37 percent less than in 1943. The cobalt (averaging 1.37 percent in 1944) is contained in the sulfides that accompany the magnetite mined at Cornwall, Pa. According to Horton:²

The ore, containing a little less than 1 pound of cobalt per ton, is separated magnetically to yield a magnetite concentrate and a non-magnetic reject; the latter amounts to 36 percent of the ore and contains 5.6 percent pyrite and 0.086 percent cobalt. The reject is treated by selective flotation to produce pyrite and chalcopyrite concentrates that represent 5.92 and 1.58 percent of the heads, respectively. The pyrite concentrate contains 88.7 percent pyrite and 1.39 percent cobalt and represents a recovery of 64.7 percent of the cobalt in the ore. It is shipped to the Davidson Chemical Co. at Baltimore, where it is roasted and the SO₂ used to make sulfuric acid. The calcine is shipped to the Pyrites Co. at Wilmington, Del., where it is treated chemically to recover the cobalt. * * *. In addition to magnetic reject currently produced, the Bethlehem company has approximately 7,000,000 tons in dumps. This dump material is estimated to contain 0.086 percent cobalt; based on 50 percent recovery, it would yield over 5,750,000 pounds.

The St. Louis Smelting & Refining Co. began producing cobalt commercially at its property near Fredericktown, Madison County, Mo., in July 1944. The property is developed by two shafts each about 400 feet deep and a third shaft bottomed at 440 feet. The complex ore is treated in a flotation mill, which yields a lead concentrate, a copper concentrate containing some lead, and a nickel-cobalt concentrate. The roasted nickel-cobalt concentrate contains about 19 percent nickel and 12 percent cobalt; some of it was shipped to the Ferro Enamel Supply Co., Cleveland, Ohio, for recovery of separate oxide products of nickel and cobalt chemically. The Bureau of Mines is installing facilities at Rolla, Mo., to investigate the production of nickel-cobalt-iron alloys from the Fredericktown ores.

The Sullivan Mining Co., Kellogg, Idaho, recovered 65 short tons of residues, containing 5,666 pounds of cobalt, at its electrolytic zinc plant. The Eastern Magnesia Talc Co., Inc., Burlington, Vt., recovered 7 tons of concentrates, containing 100 pounds of cobalt and 1,450 pounds of nickel, as a byproduct of the froth flotation of talc. However, these companies made no shipments in 1944.

According to Rasmussen:³

Development work on its cobalt holdings in the Blackbird district, Idaho, was continued by the Howe Sound Co. The ore is marginal, requiring payment for most of its copper, gold, and cobalt to be commercial. It will be tested in the Bureau of Mines small electrolytic cobalt pilot plant, assembled at Boulder City in 1944. A paper, "A Study of Impurities in Cobalt Electrowinning," presented at the 1944 meeting of the Electrochemical Society, discusses earlier investigations of Goodsprings, Nev., stainerite ore and recent studies of the Blackbird cobaltite.

¹ Forward, F. A., and Lyle, A. G., Recovery of Cobalt, Copper, and Gold from an Arsenical Concentrate by Roasting and Leaching: Inst. of Min. and Met., Bull. 470, London, January 1945, pp. 16-18.

² Horton, F. W., Production Problems Face Ferro-Alloy Metallurgists: Eng. and Min. Jour., vol. 145, No. 2, February 1944, (cobalt) p. 104.

³ Rasmussen, R. T. C., Interest in Ferro-Alloy Metals Centers on Plants: Eng. and Min. Jour., vol. 146, No. 2, February 1945, (cobalt) p. 131.

The cobalt-bearing manganese deposits of Alabama, Georgia, and Tennessee have been described by Pierce.⁴ According to Pierce:

Of the 101 manganese mines and prospects that were examined for appraisal of their cobalt possibilities, only a few were found to contain appreciable quantities of cobalt. It is estimated that the deposits examined contain, altogether, 7,900 tons of manganese oxides containing $\frac{3}{4}$ to $1\frac{1}{2}$ percent cobalt, or about 165,000 pounds of cobalt. Other deposits, in which the manganese oxides contain 0.2 to 0.3 percent cobalt, might supply 25,000 tons of manganese oxides containing about 140,000 pounds of cobalt.

FOREIGN TRADE⁵

Imports.—Imports of cobalt into the United States in 1944 were 32 percent less than those in 1943, which, however, was a record year. Since the invasion of Belgium, where Belgian Congo cobalt was formerly refined, Belgian Congo has been the chief source of imports into the United States; in 1944 it supplied 8,500,516 pounds in the form of an alloy containing 3,737,000 pounds of cobalt. French Morocco supplied 185,460 pounds of ore containing 28,413 pounds of cobalt. Canada supplied 73,088 pounds of metal, 288,069 pounds of ore containing 32,710 pounds of cobalt, and 225,609 pounds of oxide estimated to contain 158,100 pounds of cobalt.

Cobalt imported for consumption in the United States, 1940-44, by classes¹

Year	Alloy			Ore			Metal	
	Pounds		Value	Pounds		Value	Pounds	Value
	Gross weight	Cobalt content		Gross weight	Cobalt content			
1940	7,843,828	(?)	\$3,364,294	2,653,891	(?)	\$296,575	130,321	\$207,345
1941	9,970,589	4,064,276	4,330,085	2,443,725	262,653	257,702	554,030	\$42,288
1942	10,313,867	4,188,687	3,971,056	834,797	91,597	99,898	148,304	228,452
1943	10,110,879	4,357,335	(?)	10,556,042	1,268,788	1,620,869	266,670	373,948
1944	8,500,516	3,737,000	(?)	473,529	61,123	53,434	73,088	102,336

Year	Oxide		Sulfate		Other salts and compounds	
	Pounds	Value	Pounds	Value	Pounds	Value
1940	756,759	\$1,124,554	11,468	\$7,818	—	—
1941	38,002	55,120	4,480	3,779	500	\$885
1942	—	—	—	—	200	448
1943	58,928	95,463	—	—	56	164
1944	225,609	400,356	—	—	115	354

¹ In addition to classes shown, 4,796,000 pounds of Burmese speiss, containing 335,721 pounds of cobalt, were reported by processor to Bureau of Mines as imported in 1941; value not available.

² Data not available.

³ Includes 2,384,915 pounds of alloy, containing 980,000 pounds of cobalt and valued at \$867,799, received in December 1942 but recorded as January 1943 by U. S. Department of Commerce.

⁴ Reported by importer to Bureau of Mines; not separately classified by U. S. Department of Commerce.

⁵ Recorded by U. S. Department of Commerce as 12,253,292 pounds, containing 1,995,168 pounds of cobalt and valued at \$2,270,889; these figures, however, include some alloy.

Exports.—Exports of cobalt are relatively small, as is evident from the next table. Cobalt metal and alloys comprised the bulk of the exports in 1943 and 1944, and virtually all went to the Union of Soviet Socialist Republics.

⁴ Pierce, W. G., Cobalt-Bearing Manganese Deposits of Alabama, Georgia, and Tennessee: Geol. Survey Bull. 940-J, 1944, 21 pp.

⁵ Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Cobalt exported from the United States, 1942-44, by classes

Class	1942		1943		1944	
	Pounds	Value	Pounds	Value	Pounds	Value
Ore and concentrates.....	1, 052	\$1, 015	38, 755	\$58, 182	5	\$33
Metal and alloys.....	90, 679	135, 229	368, 989	537, 664	348, 439	520, 763
Oxide.....	12, 079	18, 540	14, 699	29, 105	92, 031	183, 158
Salts and compounds.....	15, 056	7, 255	20, 836	17, 955	40, 046	30, 488

CONSUMPTION

Refiners or processors.—Consumption of cobalt contained in alloy, ore, concentrate, and speiss by refiners or processors was 5,457,000 pounds in 1944, compared with 5,394,000 pounds in 1943. In addition, the cobalt content of other cobalt raw materials consumed by refiners or processors in 1944 was as follows: Fines, 283,905 pounds; hydrate, 128,767 pounds; carbonate, 17,838 pounds; low-grade oxide, 1,045 pounds; and rondelles, 788 pounds. Thus, the total cobalt content of cobalt raw materials consumed by refiners or processors was 5,889,343 pounds in 1944, of which 89 percent was processed to metal, oxide, and hydrate, and 11 percent was used in making salts and driers.

Refiners or processors of cobalt in the United States in 1944

Refiner or processor	Location of plant	Cobalt product ¹ made	Cobalt raw material ¹ used
African Metals Corp.....	Niagara Falls, N. Y.....	A, B, C, F.....	G.
Ceramic Color & Chemical Manufacturing Co.....	New Brighton, Pa.....	C, D, E.....	G.
Chase Driers & Chemicals, Inc., W. S.....	Pittsburgh, Pa.....	F.....	D.
Ferro Drier & Chemical Co.....	Bedford, Ohio.....	E, F.....	B, H.
Ferro Enamel Supply Co.....	Cleveland, Ohio.....	C, D.....	G.
Harshaw Chemical Co.....	do.....	E, F.....	B, G.
McGean Chemical Co.....	do.....	E, F.....	B, I.
Malinckrodt Chemical Works.....	St. Louis, Mo.....	E.....	B.
Nuodex Products Co., Inc.....	Elizabeth, N. J.....	F.....	B, D.
Pyrites Co., Inc., The.....	Wilmington, Del.....	A, C, D, E.....	G.
Shepherd Chemical Co.....	Cincinnati, Ohio.....	C, E, F.....	C, D, G.
Standard Oil Co. of California.....	Richmond, Calif.....	F.....	A, B.
Hilton-Davis Chemical Division, Sterling Drug, Inc.....	Cincinnati, Ohio.....	F.....	I.
Stresen-Reuter, Inc., Frederick A.....	Chicago, Ill.....	E, F.....	B, D, H.

¹ Abbreviations: A, metal (rondelles, granules, powder); B, fines; C, oxide; D, hydrate; E, salts; F, driers; G, ore, alloy, concentrate, or speiss; H, carbonate; I, cobalt solution in process or reworking residues.

Industrial consumers.—Consumption of cobalt (exclusive of salts and driers) by industrial consumers was 3,988,912 pounds in 1944, an increase of 2 percent over 1943; about 95 percent was used for metallic purposes and 5 percent for nonmetallic applications. The largest use for cobalt in 1944 was for stellite and stellite-type alloys, but 18 percent less cobalt was thus used than in 1943. The second-largest amount was employed in magnets, which used 28 percent more cobalt than in 1943. More cobalt also was used in carbide-type alloys, ground-coat frit, and pigments than in 1943, but less was used in high-speed steel. The quantity of cobalt salts and driers used is not known; however, in 1944 production of salts was 2,044,000 pounds containing 257,000 pounds of cobalt, and output of driers was 6,590,000 pounds containing 396,000 pounds of cobalt.

*Cobalt consumed in the United States, 1943-44, by uses*¹

[Exclusive of salts and driers]

Use	Pounds of cobalt	
	1943	1944
Metallic:		
High-speed steel.....	399, 736	361, 437
Stellite and stellite-type and carbide-type alloys.....	2, 041, 409	1, 757, 673
Magnets.....	1, 032, 374	1, 322, 097
Welding rod and stock for tipping tools.....	70, 068	89, 061
Dies and valve steel.....	29, 604	36, 865
Other.....	186, 664	233, 782
Total metallic.....	3, 759, 855	3, 800, 915
Nonmetallic:		
Ground-coat frit.....	80, 504	116, 884
Pigments.....	39, 384	53, 654
Other.....	35, 415	17, 459
Total nonmetallic.....	155, 303	187, 997
	3, 915, 158	3, 988, 912

¹ Comprises metal, oxide, purchased scrap, and cobalt-nickel compound, and ore used directly in magnets and other industrial applications.

WORLD PRODUCTION

As cobalt-production data for many countries are lacking, it is impossible to prepare an accurate statement of world output. The following table shows world production by countries, 1938-44, insofar as statistics are available.

*World production (partly estimated) of cobalt, 1938-44, by countries, in metric tons*¹

[Compiled by B. B. Waldbauer]

Country ¹	Cobalt-bearing material	Cobalt content						
		1938	1939	1940	1941	1942	1943	1944
Australia.....	Cobalt oxide ²	20	20	18	20	20	15	13
Belgian Congo.....	Cobalt alloy.....	1, 532	(³)	1, 423	1, 844	1, 900	1, 976	1, 695
Burma (exports).....	Cobalt ore.....			2	2	(³)	(³)	(³)
Burma.....	Cobaltiferous nickel speiss.....	238	229	218	73	(³)	(³)	(³)
Canada.....	Cobalt ores, oxide, and metal.....	208	332	360	119	38	80	17
Monaco, French.....	Cobalt ore.....	720	730	365	79	3	275	(³)
Northern Rhodesia.....	Cobalt alloy.....	1, 073	1, 598	(³)	(³)	(³)	(³)	(³)
United States.....	Cobalt ore.....			(³)	(³)	(³)	(³)	(³)

¹ In addition to countries listed, Brazil, Chile, China, Finland, Germany, Italy, Japan, Mexico, Spain, and Sweden produce cobalt, but production data are not available.

² Produced from Australian ore.

³ Data not available.

⁴ Imports into United States.

⁵ Less than 1 ton.

⁶ Year ended June 30, of year stated.

⁷ Bureau of Mines not at liberty to publish figures.

Belgian Congo.—Belgian Congo continues to be the world's chief source of cobalt. Production data for many years are not available for publication. However, following the German invasion in 1940 of Belgium, where Belgian Congo alloy formerly was processed, the entire output has been shipped to the United States; during 1944 imports were 1,695 metric tons, compared with an average of 1,786 tons during the 4 years 1940-43.

Canada.—Production of cobalt (content) in Canada declined to 38,452 pounds in 1944 from 175,961 pounds in 1943. The decline was probably due largely to the withdrawal of the Metals Reserve Co. as a purchaser of Canadian cobalt. The Silanco Mining & Smelting Corp., N. B. Davis, and the O'Brien custom mill operated by C. V. J.

O'Shaughnessy were the chief producers in 1944. Deloro Smelting & Refining Corp. continued to refine cobalt alloy mainly from Northern Rhodesia and chiefly for the British market. The Silanco Mining & Smelting Corp. has decided to proceed with plans for the erection of a smelter with a capacity for smelting and refining 10 tons of cobalt concentrates daily at Cobalt, Ontario, where the company operates a concentrator and mines cobalt-silver ore from several properties.⁶

Chile.—According to Hudson:⁷

• The production of cobalt has also been increased through the economic cooperation given to the Cobaltera S. A., which is working a deposit of low grade in Freirina. The help of the corporation (Fomento) has made it possible for this company to construct a concentration plant for improving the grade of the ore, and provided the capital necessary to begin production. At the present time the plant is producing approximately 1,000 kilograms of carbonate of cobalt a month. Within a short time it will produce oxide of cobalt which can be readily distributed and sold on the market. At the same time, various cobalt mines are being studied which are near the plant.

Finland.—Finland became a producer of cobalt about 1936, but figures on output are lacking. However, during the three years 1937–39 an average of 202,697 pounds of metal and 105,700 pounds of oxide was imported into the United States from Finland. Finnish cobalt no doubt contributed a large part of Germany's supply before relations between the two countries were broken.

French Morocco.—For a number of years before its occupation by Germany, French Morocco was a relatively small but important producer of cobalt. During the period between the landing of the Allied forces and December 1943 the entire production was allocated to the United States, and 4,529 short tons containing 1,126,641 pounds of cobalt were shipped. In addition to cobalt, the ore contains 5 to 30 grams of gold to the ton. The mine (Bou Azzer) is about 186 miles from the railroad at Marrakech, and because of its inaccessible location and lack of trucks to haul the ore no shipments have been made since December 1943. According to Brooks:⁸

The cobalt mine was opened about 9 years ago * * * and is fairly modernly equipped. Cobalt deposits are not found in a continuous vein or lode but in pockets, making much exploratory work necessary before mining operations can begin. These pockets are in solid rock over a width of about 80 feet. Proved resources are 36,000 metric tons, permitting 10 years' operation at the rate of 300 tons per month, but there is every reason to believe that vastly larger deposits exist. Production is now 200 metric tons per month of 12-percent cobalt. At present the mine has several levels, the deepest being 175 meters (574 feet). * * *

Since the American landing in Morocco and until December 1943, the United States purchased most of the cobalt produced at Bou Azzer. No sales are known to have been made since that month, and there are around 1,400 metric tons of cobalt at the mine and 400 metric tons at the railhead at Marrakech.

Northern Rhodesia.—Northern Rhodesia is second to Belgian Congo as a producer of cobalt. Production data have not been published since 1939, when an output of 1,598 metric tons was recorded.

Spain.—Small quantities of ore averaging about 6 percent cobalt were reported produced in Leon and Oveido Provinces in 1944.

Sweden.—It is reported that cobalt, among other metals, is being obtained from Boliden ore.⁹

⁶ Northern Miner, Smelter Decided on for Cobalt: Vol. 30, No. 19, Aug. 3, 1944, p. 5.

⁷ Hudson, J. C., American Embassy, Santiago, Chile, July 31, 1944.

⁸ Brooks, R. M., American Consul, Casablanca, Morocco, Mar. 27, 1944.

⁹ Olsson, Grant, American Legation, Stockholm, Sweden, Oct. 28, 1943.

MOLYBDENUM

By EDWIN K. JENCKES AND ALICE P. VAN SICLEN

SUMMARY OUTLINE

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SUMMARY

Although domestic output of molybdenum concentrates in 1944 was about 37 percent below the 1943 record, a satisfactory balance was maintained between total production and shipments, and year-end stocks showed an increase of about 8 percent. During the first half of the year production exceeded demand, and producers' inventories rose month by month until they reached a record high of over 18 million pounds (Mo contained in concentrates) at the end of June. Subsequent large export shipments and an increase in domestic consumption absorbed excess stocks.

Imports of molybdenum in 1944 were nearly twice as great as in 1943. However, about one-third of the total comprised concentrates entering the United States from Canada for conversion to molybdenum products and return to the Dominion.

Exports of domestic molybdenum concentrates went to U. S. S. R. and the United Kingdom.

The principal use for molybdenum is in iron and steel products, and consumption follows closely the pattern of alloy-steel production. The 20-percent drop in alloy-steel output in 1944 was reflected in a similar reduction in consumption of molybdenum products.

Salient statistics of the molybdenum industry in the United States, 1940-44, in thousands of pounds of molybdenum contained in concentrates

	1940	1941	1942	1943	1944
Production.....	34,313	¹ 40,363	¹ 56,942	¹ 61,667	38,679
Imports for consumption.....		4	756	1,789	3,499
Shipments (including exports).....	25,329	¹ 38,377	66,437	¹ 53,955	39,423
Consumption.....	(²)	³ 16,891	56,388	49,891	31,520
Stocks (producers' and consumers') December 31.....	(²)	¹ 21,226	¹ 12,540	¹ 17,811	19,366

¹ Revised figure.

² Data not available.

³ 6 months, July to December.

POSTWAR OUTLOOK

The postwar production of alloy steels—major domestic use of molybdenum products—can hardly be expected to continue at the

wartime level of 10 to 13 million ingot tons a year. As a consequence, the domestic consumption of molybdenum may be expected to drop considerably, although not necessarily to prewar (1938-39) levels. One unknown factor is whether the war-initiated lower alloy steels will continue to be used for engineering purposes or whether there will be a return to the use of steels of previously accepted analyses.

A further potent factor in steel requirements for molybdenum products will be the extent to which the molybdenum-containing high-speed steels are accepted. It seems probable that many of the large users of tool steel will take advantage of the price differential possessed by the molybdenum types and continue to use them for most purposes, as war experience shows them in most instances to be an economic substitute for the conventional tungsten types (18-4-1).

The heat treatment of these steels is, however, more exacting than that of the 18-4-1 types, and this factor may cause the many small individual purchasers to return to the conventional types of high-speed steels.

Considerable foreign demand for molybdenum may be expected both for molybdenum products and for molybdenum-containing alloy steels. Two adverse economic factors would be small foreign buying power and the availability of molybdenum-bearing war scrap.

It seems, therefore, that postwar demands for molybdenum will fall sharply from the 1941-44 levels but should compare favorably with demands in the immediate prewar years.¹

WAR REGULATIONS

No new regulations governing the distribution of molybdenum were issued by the War Production Board in 1944. Molybdenum ingot, wire, and sheets continued on allocation (General Preference Order M-369, December 31, 1943). The only control over molybdenum in other forms was through the requirement that vendors furnish the War Production Board with monthly lists of all sales of molybdenum in excess of 2,000 pounds. Revocation of Direction 1 to Supplementary Order M-21-h and Supplementary Order M-21-g in January 1944 removed all restrictions from formulas for the production of molybdenum-containing and certain other alloy steels.

PRICES

Since 1938 molybdenum concentrates have been quoted in trade journals at 45 cents per pound of MoS_2 in 90-percent concentrates. This quotation represents an open market price, but contract deliveries are doubtless at a somewhat lower figure. There is no Government control over the price of concentrates.

The following quotations for molybdenum products conform to the prices established by the Office of Price Administration in MPR 489, dated November 8, 1943.

Product:	Per pound contained Mo
Ferromolybdenum.....	\$0. 95
Molybdenum oxide, technical (powder or briquets).....	. 80
Calcium molybdate.....	. 80

¹ See Minerals Yearbook, 1943, p. 651.

UNITED STATES

PRODUCTION IN 1944

Throughout most of the year domestic production of molybdenum concentrates exceeded shipments, and producers' inventories rose at midyear to over 18 million pounds of Mo contained. Increased demand in the latter half of the year reduced producers' stocks as of December 31 to approximately the quantity of concentrates on hand at the beginning of 1944. Shipments for export, reported by producers, were about 13 percent of total shipments.

Domestic shipments from 1914 to 1944, inclusive, are shown in the accompanying table:

Molybdenum in ore and concentrates shipped from mines in the United States, 1914-44¹

Year	Pounds	Value ²	Year	Pounds	Value ²
1914-18.....	1,601,643	\$2,070,213	1940.....	25,329,000	\$17,189,000
1919-23 ³	355,493	370,371	1941.....	38,377,000	25,996,000
1924-28.....	8,498,343	6,160,304	1942.....	66,437,000	47,275,000
1929-33.....	18,954,917	11,406,000	1943.....	53,955,000	38,500,000
1934-38.....	94,077,000	64,244,000	1944.....	39,423,000	27,990,000
1939.....	32,415,000	22,157,000			

¹ For shipments by years, 1914-38, see chapter of this series for 1941.

² Largely estimated by Bureau of Mines.

³ No shipments in 1920 and 1921.

⁴ Revised figure.

Recovery of molybdenum by copper producers continued at about the same rate as in 1943, but owing to smaller output by other producers copper ores contributed about 35 percent of the total domestic production compared with about 22 percent in 1943. As the accompanying table indicates, only 3 of the 11 domestic producers of molybdenum concentrates in 1944 obtained their product from molybdenum ore; the others recovered molybdenum as a byproduct of copper or other operations. The molybdenum content of ores treated ranges from as little as 0.02 percent in some copper ores to 5.75 percent in the Questa (N. Mex.) molybdenite ore. The Climax ore averages only about 0.6 percent, and the success of the enterprise is due to the enormous quantity of ore available as well as to the efficient mining and milling program that has been developed throughout the years.

Producers of molybdenum concentrates in the United States in 1944

Type of ore	Molybdenum mineral	Location of mine	Operator
Molybdenum.....	Molybdenite.....	Climax, Colo.....	Climax Molybdenum Co.
Do.....	do.....	Urad, Colo.....	Molybdenum Corp. of America.
Do.....	do.....	Questa, N. Mex.....	Do.
Copper.....	do.....	Miami, Ariz.....	Miami Copper Co.
Do.....	do.....	Bagdad, Ariz.....	Bagdad Copper Corp.
Do.....	do.....	Camp Verde, Ariz.....	Squaw Peak Copper Mining Co.
Do.....	do.....	Ruth and Kimberly, Nev.	Kennecott Copper Corp., Nevada
Do.....	do.....	Santa Rita, N. Mex.	Mines Div. 1
Do.....	do.....		Kennecott Copper Corp., Chino
Do.....	do.....	Bingham, Utah.....	Mines Div.
Tungsten.....	Molybdenite and powellite.	Pine Creek, Calif.....	Utah Copper Co.
Complex (Au, Ag, Pb, Mo, V).	Wulfenite.....	Tiger, Ariz.....	United States Vanadium Corp.
			Mammoth-St. Anthony, Ltd.

¹ Ore of the Consolidated Coppermines Corp. is milled in same circuit with Kennecott ore.

REVIEW BY STATES

Arizona.—In 1944 four producers recovered a total of 4,270 tons of molybdenum concentrates containing 834,000 pounds of Mo. All were byproduct operations—three from copper mining and the fourth from complex (gold-silver-lead, zinc-molybdenum-vanadium) ores.

Miami Copper Co. began producing molybdenite in 1938 from copper ores mined at Miami, Ariz. The concentrates are roasted at the company plant and shipped to an eastern market. Bagdad Copper Corp., which had been experimenting with molybdenum recovery for some time, began shipments early in 1944 and apparently has succeeded in lowering the copper content of molybdenum concentrates to an acceptable figure. Year-end shipments by the Squaw Peak Copper Mining Co., Camp Verde, Ariz., to Metals Reserve Company, Phoenix, Ariz., constitute the only purchases of domestic molybdenum under the small-lot purchasing program announced July 8, 1943.²

During the first half of 1944 Mammoth-St. Anthony, Ltd., recovered molybdenum from complex ores mined at Tiger, Ariz., and produced calcium molybdate. Molybdenum operations were suspended in July in order that the company might concentrate its efforts on lead and zinc production. Shortly thereafter the Mammoth shaft and some buildings were damaged by fire.

California.—The United States Vanadium Corp. continued recovery of molybdenite concentrates from tungsten operations at Bishop, Calif. The ore also contains a powellite mineral from which molybdenum trisulfide is extracted. Shortage of manpower caused productive mining operations to be suspended late in the year.

Colorado.—Although producing at approximately half the phenomenal rate of 1943, Climax Molybdenum Co. continued as the leading producer of molybdenum in the world. Production was 22,527 short tons of molybdenite concentrates, containing 23,608,421 pounds of molybdenum, compared with 45,589 tons, containing 46,133,715 pounds, in 1943. Many articles have been published describing mining and milling methods employed by the company. Among those that appeared in 1944 are the following:

BUCKY, PHILIP B. Block Caving at Climax. *Explosives Eng.*, vol. 22, No. 2, March–April 1944, pp. 76–79.

CUTHBERTSON, R. E. Unusual Reagent Combination Improves Flotation at Climax Molybdenite Mine. *Am. Inst. Min. and Met. Eng., Tech. Pub.* 1675, 19 pp.; *Min. Technol.*, vol. 8, January 1944.

WHEELER, E. S. Climax Conversion Practice. *Am. Inst. Min. and Met. Eng., Tech. Pub.* 1718, 11 pp.; *Metals Technol.*, vol. 11, August 1944.

The paper by Wheeler is of special interest in that it describes in considerable detail the company processing plant at Langeloth, Pa., and the methods employed for producing calcium molybdate, roasted concentrates and briquets, ferromolybdenum, pure oxide, sodium molybdate, and molybdenum silicide. Shipments of molybdenum products from 1924 to 1942 are also given.

Production of molybdenum concentrates at the Urad property near Empire, Colo., was begun in May 1944 by the Molybdenum Corp. of America and continued throughout the year. Labor shortages hampered both underground and surface operations and prevented capacity operation of the 200-ton mill. The crushing plant is large

² For description of plant see: *Mining World*, Squaw Peak-Initial Pilot Plant Runs Indicate Promising Future for Molybdenum Development, Camp Verde, Ariz.: Vol. 6, No. 9, September 1944, p. 36.

enough to permit expansion of the flotation unit. It is understood that problems encountered in working out the flow sheet have been solved. A description of the mine and mill appeared in Skillings' Mining Review.³

Nevada.—Molybdenum has been recovered since 1941 at the McGill copper concentrator of Kennecott Copper Corp. In addition to copper ore from Kennecott's Ruth mine and its Copper Flat open pit, ore produced at the Consolidated Coppermines Corp. Emma Nevada group is milled; the ores are mixed before treatment. Production figures for the McGill concentrator were not reported separately to the Bureau of Mines until 1944.

New Mexico.—The two producers of molybdenum in New Mexico continued production throughout the year. The Molybdenum Corp. of America mine near Questa has been operated since 1919 and is one of the three properties in the United States worked solely for molybdenum. Mining operations have been simplified somewhat by the driving of a new tunnel. The Chino Mines Division of Kennecott Copper Corp. has recovered molybdenum as a byproduct of copper operations since 1937.

Utah.—Byproduct recovery of molybdenum from copper ore milled by the Utah Copper Co. at Arthur and Magna is the second largest domestic source of molybdenum. The company is the only producer in the State.

EXPLORATION AND DEVELOPMENT

A report of investigation,⁴ published recently by the Bureau of Mines, summarizes exploration by the Bureau during the past 2 or 3 years at the following properties: Amargosa Molybdenum Corp., Pima County, Ariz.; Big Ben mine, Cascade County, Mont.; Boy Scout and Moss properties, Halifax County, N. C.; and Muir Inlet, southeastern Alaska.

The Geological Survey made no new examinations of molybdenum deposits in 1944. Further geologic work was carried on, however, at the Hall property, Nye County, Nev., and the Starr property, Okanogan County, Wash. Geologic investigations of several known deposits are contemplated for the coming year to complete a survey of the larger molybdenum deposits of the United States.

Preparations have been made to release the maps of the Starr and Big Ben deposit, Cascade County, Mont., during 1945.

The Geological Survey made no extensive investigations of molybdenum deposits in Alaska during 1944. In the course of other work, a small deposit of apparently low-grade molybdenum was briefly examined near the southern end of the Kaiyuh Hills, about 70 miles south of the town of Kaltag. The gold-copper-molybdenum deposit at Orange Hill, Chisana district, was also briefly examined.

CONSUMPTION AND USES

Molybdenum is consumed principally in alloy-steel ingots and castings. It is used also in iron castings, and a small quantity is

³Skillings' Mining Review, Urad Molybdenum Mine in Colorado: Vol. 33, No. 47, Mar. 10, 1945, p. 1.

⁴Jullien, C. E., and Moon, Lowell B., Summary of Bureau of Mines Exploration Projects on Deposits of Raw Material Resources for Steel Production: Bureau of Mines Rept. of Investigations 3801, 1945, pp. 32 and 33.

employed in pigments and colors, welding-rod coatings, and miscellaneous chemical products. Because molybdenum is readily available from domestic sources and can be used in place of other less-abundant steel-alloying elements, it has been an important material in the war program. Molybdenum concentrates usually are converted to molybdenum products, such as ferromolybdenum, calcium molybdate, and molybdic oxide (roasted molybdenite) before being used. In recent years the oxide, in cans or mixed with a pitch binder to form briquets, has found great favor with consumers. These cans and briquets, each of which contains an exact quantity of Mo, make possible the addition of this relatively expensive alloying material without the necessity of maintaining a weighing room. Moreover, molybdenum in the oxide form can be thus introduced into steel at a substantially lower cost. Shipments for export are predominantly in the form of concentrates and ferromolybdenum; the latter material has the advantage of requiring a smaller volume of shipping space for a given weight of contained Mo. A small quantity of concentrates (about 60,000 pounds of contained Mo in 1944) is used by a few steel companies as an addition to the molten metal in the ladle to raise the sulfur content to improve machinability, in addition to gaining the benefit of the contained Mo.

The Bureau of Mines has collected molybdenum-consumption figures since July 1941. A complete coverage of consumers of molybdenum products was maintained until January 1944, when a number of small users, taking about 5 percent of the December 1943 consumption, were relieved from further reporting. Although the 1944 totals given in the accompanying table are not directly comparable with those for the two preceding years, the indicated relative demand for individual products is believed to be reliable.

Consumption of molybdenum products in the United States, July 1941–December 1944, in thousands of pounds of contained molybdenum

Year	Ferromolybdenum	Calcium molybdate	Molybdenum oxide ¹	Other ²	Purchased scrap	Total
1941 ³	3,899	2,724	6,546	372	510	14,051
1942	10,673	5,501	27,824	414	1,252	45,664
1943	6,663	5,099	26,383	580	2,940	41,665
1944	4,617	2,351	21,303	631	2,777	31,679

¹ Includes also molybdenum trioxide and molybdic acid, 1942–44.

² Ammonium molybdate, sodium molybdate, molybdenum silicide, molybdenum metal, and alloys; also molybdenum trioxide and molybdic acid in 1941.

³ July to December.

The volume of molybdenum consumed in the form of metal is insignificant. However, this item is of considerable importance; and, as noted in the discussion of War Regulations, molybdenum metal is the only molybdenum product under allocation. Production of wire, rod, and sheet for lamps and tubes requires technical skill by trained workers and is performed by only a few companies in the United States. The process employed by one producer has been described in steel.⁴

The percentages of Mo used in steel cover a considerable range. The molybdenum high-speed tool steels may contain as much as 9

⁴ Steel, Drawing Tungsten and Molybdenum Wire: Vol. 116, No. 13, Mar. 26, 1945, pp. 90–91, 110.

percent Mo whereas the Mo content of engineering steels does not often exceed 0.30 percent. The ratio of production of molybdenum-containing high-speed steels to straight tungsten high-speed steels varies with the relative abundance of the two elements. For example, during 1942 and part of 1943, 75 percent of all high-speed steel orders accepted in any one quarter were required to be of the molybdenum type and not more than 25 percent of the tungsten type. Molybdenum high-speed steels have been investigated by various steel companies for many years. Probably the best-known early patents are those of the Cleveland Twist Drill Co., covering the now widely distributed Mo-Max type. The basic composition is approximately as follows: Carbon 0.78–0.84 percent, chromium 3.50–4.00, molybdenum 8.20–9.40, tungsten 1.30–2.00, and vanadium 1.00–1.30. In the fall of 1944 three motor companies were reported⁶ to be advocating standardization of a 6 Mo–6 W type of high-speed steel developed by the Allegheny Steel Corp. A typical analysis of this steel is: C 0.79–0.87 percent, Cr 3.90–4.40, W 6.00–6.75, Mo 4.75–5.25, and V 1.75–2.05. (In this analysis the lower molybdenum content is offset by an increase in vanadium.)

During the war years every effort has been made to substitute the lower-alloy-content NE (National Emergency) steels for the conventional SAE steels, to conserve critical alloying elements used as additives. Currently used NE steels containing molybdenum are in the following series: NE 52100–A–B–C, NE 8600, 8700, 9400, 9700, 9800, and 9900. Analyses of NE steels and lists of their uses were published in *Metal Progress*;⁷ the part played by molybdenum in the NE steel program is discussed in a comprehensive review by Mather.⁸

The feasibility of using battlefield scrap with a high nickel, chromium, and molybdenum content is discussed in a current article in *Steel*.⁹

FOREIGN TRADE¹⁰

Imports have never been an important factor in the molybdenum industry of the United States. In most years they have amounted to only a few thousand pounds of molybdenum in ores and concentrates. The advent of receipts from Chile in 1942 had a noticeable effect upon import totals, which have about doubled each year subsequently. However, none of the material recorded in the accompanying import table enters domestic trade. (Additional molybdenum from Mexico, which entered the United States in bond for export, is not included in the record of "imports for consumption.") Molybdenum concentrates received from Canada are converted to molybdenum products at a processing plant in the eastern United States and returned to Canada.

Export statistics of molybdenum ores and concentrates have been compiled by the United States Department of Commerce since 1939. No official records are available for earlier years, but various estimates

⁶ Steel, Leading Motor Companies Favor Standardization of 6-6 or Molybdenum-Type High-Speed Steel for Bulk of Tool Requirements: Vol. 115, No. 19, Nov. 6, 1944, p. 93.

⁷ Metal Progress, Index of Uses for National Emergency Steels (compiled by Research Dept., Bethlehem Steel Co.): Vol. 46, No. 1, July 1944, pp. 91–94 and 96 B.

⁸ Mather, Roger F., The American National Emergency Steels—Their Evolution, Present Status and Future: *Metallurgia*, vol. 30, No. 178, August 1944, pp. 197–201.

⁹ Steel, Production of Steel from Battlefield Scrap: Vol. 116, No. 14, Apr. 2, 1945, pp. 105 and 146.

¹⁰ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

of export shipments published from time to time were usually in the range of 50 to 75 percent of the United States total shipments. During the war years exports of molybdenum in concentrates have represented about 25 percent or less of total shipments from domestic mines. In 1944, exports were only 15 percent (13 percent if material of Canadian origin is excluded) compared with 19 percent in 1943 and 17 percent in 1942. In addition, considerable quantities of ferromolybdenum are shipped abroad. In 1944, 4,427,581 pounds of ferromolybdenum valued at \$2,665,920 were exported compared with 1,115,844 pounds valued at \$710,224 in 1943 and 6,089,953 pounds valued at \$3,317,301 in 1942.

Imports and exports of molybdenum ore and concentrates in 1943 and 1944 appear in the accompanying tables.

Molybdenum ore and concentrates imported for consumption in the United States, 1943-44, by countries

Country	1943			1944		
	Pounds		Value	Pounds		Value
	Gross weight	Molybdenum content		Gross weight	Molybdenum content	
Cameroon.....	1,135	284	\$150			
Canada.....	1,443,176	1,216,398	205,716	1,245,520	1,143,440	\$1,086,072
Chile.....	2,592,636	1,405,228	922,483	3,811,772	2,164,888	1,285,127
Mexico.....	21,429	11,000	6,172	39,178	22,296	15,622
Peru.....	270,296	155,742	103,665	323,565	166,518	119,882
	3,328,672	1,788,652	1,238,186	6,420,025	3,499,142	2,506,703

¹ Imported for conversion and reexport.

Molybdenum ore and concentrates exported from the United States, 1943-44, by countries

Country	1943			1944		
	Pounds		Value	Pounds		Value
	Gross weight	Molybdenum content		Gross weight	Molybdenum content	
Australia.....	206,416	103,208	\$85,120			
Canada.....	1,642,469	843,500	654,850	1,656,097	853,906	\$683,305
India and Dependencies.....	34,000	20,900	19,683			
Southern Rhodesia.....	602	300	477			
U. S. S. R.....	8,089,076	4,110,399	2,996,541	7,958,830	4,021,005	2,758,104
United Kingdom ¹	9,738,190	4,992,850	3,470,543	2,239,846	1,110,489	727,398
	19,707,653	10,071,157	7,227,214	11,854,763	5,985,400	4,168,807

¹ United Kingdom of Great Britain and Northern Ireland.

WORLD PRODUCTION AND DEVELOPMENTS

Although authoritative information on production of molybdenum outside the Western Hemisphere is meager, it is reasonable to assume that the United States continued to lead all countries in producing this vital war material. Output of molybdenum concentrates and molybdenum products in the United States was sufficient not only to

meet the needs of domestic steel companies but to supply requirements of our Allies—notably U. S. S. R. Clues to supplies of molybdenum and other steel-alloying elements available to Germany and Japan have been found through studies of enemy ordnance recently made public.¹¹ Examinations of matériel indicated that, next to copper and nickel, Germany was probably most cramped for molybdenum. However, molybdenum appears to have been used freely in armor and projectiles. The high molybdenum content of Japanese light armor suggests that the Japanese had ample stock piles of alloying elements to enable them to use the more conventional alloy steels.

World production of molybdenum in ores and concentrates, 1938-44, by countries, in metric tons

[Compiled by B. B. Waldbauer]

Country	1938	1939	1940	1941	1942	1943	1944
Australia ¹	32	39	20	24	7	(²)	(²)
Canada ¹	3	(²)	5	46	54	186	488
Chile		30	267	229	560	680	(²)
Italy	4	4	(²)	(²)	(²)	(²)	(²)
Mexico	483	523	310	522	855	1,118	717
Morocco, French	94	84	57	29	6	8	(²)
Norway	462	433	288	233	363	227	280
Peru	85	167	190	148	154	85	62
Turkey	41	(²)	(²)	(²)	(²)	(²)	(²)
United States	15,103	13,755	15,564	18,309	25,829	27,972	17,545
Other countries ⁴	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Total ⁴	16,310	15,100	16,800	19,600	27,900	30,300	20,000

¹ Gross weight of ore and concentrates reported; molybdenum content estimated by authors.

² Estimate included in total.

³ Less than 1 ton.

⁴ Estimate.

⁵ Revised figure.

⁶ Estimate for Greece, Rumania, and Yugoslavia included in total; in addition, molybdenum ore is reduced in Burma, China, Chosen, Finland, France, Japan, Manchuria, Sweden, and U. S. S. R., but data of production are not available.

Canada.—The Government-stimulated molybdenum development program undertaken in 1941 resulted in a substantial increase in production of molybdenite concentrates in the Dominion. The price incentive of 85 cents per pound of contained sulfide in concentrate containing 80 percent or more (compare U. S. market quotation of 45 cents per pound for 90-percent concentrate) was an influential factor. By the end of 1943 a favorable supply situation had been reached, due largely to production by three producers—Indian Molybdenum, Ltd., Abitibi region, Quebec; the La Corne mine near Val d'Or, Quebec; and the Quyon Molybdenum Co., at Quyon, Quebec. By April 1944 there was reported to be between 2 and 3 years' supply of molybdenum concentrates on hand, and the Canadian Government canceled its contract with Indian Molybdenum, Ltd. Production ceased at that property on April 30, 1944. Molybdenum ore milled (68,750 tons) at the Indian Molybdenum property during the first 4 months of 1944 yielded 567,535 pounds of molybdenite.¹² Nearly all the remainder of 1944 production of molybdenum came from the La Corne project, operated by Wartime Metals Corporation. The total was about 163 percent greater than in 1943. According to

¹¹ Cady, J. R., Gillett, H. W., and Grenell, L. H. (Battelle Memorial Institute), *Enemy Matériel from the Metallurgical Point of View: Metal Progress*, vol. 47, No. 2, February 1945, pp. 280-320.

¹² Dome Mines, Ltd., *Annual Report for Year ended December 31, 1944*.

G. Shartner,¹³ manager of the La Corne molybdenum project, the 300-ton mill recovers 60 tons of 85-percent concentrate per month from the treatment of about 7,000 tons of ore; 125 tons of concentrate had accumulated at the mine up to the end of November 1944. Throughout the year Canadian concentrates were shipped to a processing plant in the United States for conversion to molybdenum products and returned to the Dominion. A review of wartime production of molybdenum in Canada and a table of production from 1902 to 1943, inclusive, appear in the 1943 Report on Miscellaneous Metals in Canada.¹⁴

Chile.—Molybdenite concentrates have been recovered from copper operations of the Braden Copper Co. since 1939. The Chuquicamata mine of the Chile Exploration Co. and the Potrerillos mine of the Andes Copper Co. have been investigated as sources of molybdenum, but recovery has not been undertaken.

Egypt.—Prospecting for molybdenite took place during 1944 near Gebel Qatter, west of the oil wells at Hurghada in the Red Sea area. Other occurrences in this area have been described by Hume.¹⁵

Germany.—Statements emanating from officials of the British and United States Governments have been widely reprinted and agree that the loss of Finland, Greece, Rumania, and Yugoslavia has deprived Germany of two-thirds of its molybdenum supplies. The production at Knaben, Norway, which was seriously curtailed by Allied bombing in 1943, is believed to be inadequate for steel needed for replacements of war matériel.

Mexico.—The decline in production of molybdenum in Mexico from 1,118 metric tons in 1943 to 717 metric tons in 1944 was due largely to labor difficulties at the Greene Cananea mine, which is the leading source of molybdenum in that country. Except for small purchases by Metals Reserve Company, all shipments are transshipped through the United States under bond and are not included in either the import or export statistics of the United States. During the war period Mexican molybdenum has been purchased by the United States for shipment to the Allied Nations.

Peru.—According to Vanderburg,¹⁶ the Peru Molibdeno, S. A., only steady producer of molybdenum in Peru, closed its concentrator in October 1944 because of lack of ore but continued exploration and development work. In 1944 the company milled 23,104 metric tons of ore averaging 0.453 percent MoS_2 , from which 104.1 metric tons of concentrates containing 82.73 percent MoS_2 were recovered. The Metals Reserve Company contract with Peru Molibdeno for the purchase of molybdenum concentrates, dated May 1, 1943, was canceled on January 12, 1945, effective 90 days from the date of notification.

Rumania.—Production of molybdenum is reported to have increased considerably during the war years. Interest in developments in the Rumanian industry lies not so much in the volume of production, which is not impressive when compared with that of Western Hemisphere countries, but in its relationship to Germany's supply of ferro-alloying metals. Apparently the accelerated rate of production in Rumania served as partial compensation for losses in other fields.

¹³ Engineering and Mining Journal, vol. 146, No. 2, February 1945, p. 174.

¹⁴ Canada, Department of Trade and Commerce, Dominion Bureau of Statistics, Census of Industry—Mining, Metallurgical, and Chemical Branch. Report on Miscellaneous Metals in Canada, 1943, 33 pp.

¹⁵ Hume, William F., The Geology of Egypt: Survey of Egypt, Ministry of Finance, vol. 2, part 3, Cairo, 1937, pp. 843-845.

¹⁶ Vanderburg, Wm., Consular Report 28 (unrestricted), Lima, Peru, Jan. 23, 1945, pp. 2 and 3.

The principal producer has been Molybden, S. A., of Bucharest, which obtains molybdenum from molybdenum-bismuth ore mined at Baita, Judetul of Bihor.

*Sweden.*¹⁷—Wartime search for molybdenum continued in several areas in Sweden during 1944. Before the war Sweden is not known to have produced molybdenum, and the requirements of the Swedish steel industry were met from outside sources. An annual output of 90,000 tons of ore "with a considerable molybdenum content" is anticipated from the Ål mine in Lillhärad Parish. The Swedish Geological Survey reported the discovery of low-grade molybdenum deposits in 1943 at Aijajarvi in the Parish of Jukkasjärvi in northern Sweden. Small quantities of molybdenum were also discovered at the Drugge mine in the Parish of Jokkmokk. During 1943 the Riddarhytte A. B. began recovering molybdenum at the Källefallat mine at Riddarhyttan in Västmanland Province and built a concentration plant. Treatment of waste material from the operation, containing between 0.1 and 0.2 percent MoS_2 , began in 1944. Deposits of associated molybdenum and tungsten ores are reported as being worked in the Yxsjö and Hork fields, Örebro County.

U. S. S. R.—Although production statistics are lacking, references in the press to exploitation of numerous molybdenum deposits in Russia indicate that molybdenum has been produced since 1918.¹⁸ As in the United States, molybdenum has been recovered from molybdenum ores and also as a byproduct of copper operations. In 1944 discovery of a deposit of molybdenum ore ranging from 0.6 to 0.8 percent Mo was reported in Azerbaidzhan. The property apparently offered sufficient promise to justify construction of a mill, power plant, and housing facilities for workers.¹⁹ Molybdenum recovery continued at the copper operation on Lake Balkhash in Kazakstan,²⁰ where a molybdenum plant was built in 1940.

¹⁷ Donogh, R. P., and Stough, D. B., Sweden's Unique Iron-Ore Position: *Foreign Commerce Weekly*, vol. 18, No. 2, Jan. 6, 1945, pp. 4-8, 42-46.

¹⁸ Bureau of Foreign and Domestic Commerce, Russia's Increasing Importance in Rare Elements: *Foreign Trade Notes*, vol. II, No. 15, July 28, 1933, p. 6.

¹⁹ Consular Report 1099, Moscow, Oct. 16, 1944.

²⁰ Daily Metal Reporter, vol. 44, No. 224, Nov. 18, 1944, p. 5.

VANADIUM

By EDWIN K. JENCKES AND ALICE P. VAN SICLEN

SUMMARY OUTLINE

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SUMMARY

Domestic production of vanadium ores in 1944 dropped to 3,527,054 pounds of contained vanadium from an all-time high of 5,586,492 pounds recorded in 1943. Metals Reserve Company purchases of vanadium ore, which comprised about 43 percent of the total 1943 mine shipments, in terms of contained metal, ceased at the end of February 1944 and represented only about 10 percent of the 1944 shipments. Lacking the stimulus afforded by the Government purchasing program, many small producers withdrew from vanadium mining. Although reserves of vanadium-bearing materials are scattered widely over the United States, commercial production comes from five Western States of which Colorado is the leading one.

Imports of vanadium, largely in the form of concentrates, were all from Peru. The 1944 total was the smallest since 1937. Exports of ore and concentrates were insignificant, but an appreciable quantity of ferrovanadium was shipped abroad.

Consumption of domestic vanadium ores, although 20 percent below the 1943 total, was maintained at a high figure, largely because of the installation of certain facilities for reworking waste vanadium-containing materials.

Salient Statistics of the vanadium industry in the United States, 1941-44, in pounds of vanadium contained

	1941	1942	1943	1944
Mine shipments of ores and concentrates ¹	2, 513, 051	4, 439, 130	5, 586, 492	3, 527, 054
Imports:				
Ore or concentrates.....	2, 138, 608	2, 422, 376	2, 052, 620	1, 284, 603
Vanadium-bearing flue dust.....	(3)	154, 028	64, 393	40, 171
Exports of ore, concentrates, and vanadium oxide.....	25, 462	22, 140	38, 180	6, 254
Consumption ²	2, 393, 478	3, 914, 673	5, 179, 290	4, 113, 309

¹ Measured by receipts at mills and Government purchasing depots.

² Data not available.

³ Domestic ores only.

POSTWAR OUTLOOK

The commercial position of vanadium in the postwar period is markedly similar to that of molybdenum,¹ with the single exception that vanadium is not substitutable for tungsten as is molybdenum. It is to be expected, therefore, that vanadium consumption will drop from wartime levels to a point near the 1935-39 average.

¹ Jenckes, Edwin K., and van Siclen, Alice P., Molybdenum; Bureau of Mines Minerals Yearbook 1944, section on Postwar Outlook.

The restrictions on uses of vanadium were much more severe than those placed on other alloying additives used in the production of alloy steels, and there would seem, therefore, to be a very large backlog of unsatisfied civilian demand for vanadium-containing steels. Enforced wartime economics have resulted in reappraisal of the utility of vanadium in some applications, but, unquestionably, wartime experience also has developed new requirements for the element.

No attempt can be made to estimate closely the probable postwar domestic production of vanadium ore because of possible shifts between domestic and foreign sources of supply. Present stocks of vanadium ores and partly or fully refined vanadium-bearing materials seem to be adequate to take care of any predictable emergency.

WAR REGULATIONS

Allocation controls over the distribution of vanadium, provided by War Production Board General Preference Order M-23, were removed on December 30, 1943, by amendment of the order. However, under the amended order, sellers are required to report to the Board all sales of 500 pounds or more of vanadium in ferrovanadium or commercial vanadium pentoxide in any one month. Order M-21-a provides for submission of melt schedules to the Board for authorization of the use of vanadium in alloy steels. Effective October 1, 1944, imports of vanadium ceased to be subject to Government control under General Imports Order M-63.

PRICES

Vanadium ore has been quoted in trade journals at 27½ cents per pound of contained V_2O_5 since 1935. As a result of wartime demand for vanadium, prices actually paid have been at a considerably higher level, and in 1944 sales to Metals Reserve Company at as much as 60 cents per pound were reported. Private mill operators apparently purchased ores at lower figures. No standard price schedule was issued by the Metals Reserve Company, and all purchases by that agency were made on the basis of individual contracts, depending on grade of ore, distance from purchase depots, and other factors. The price of vanadium ore is not governed by Office of Price Administration Maximum Price Regulation 489, which became effective November 8, 1943. The Regulation does, however, provide for the following prices for ferrovanadium and vanadium pentoxide, which remained in effect throughout 1944:

Ferrovanadium.—Per pound of contained vanadium, standard crushed sizes, f. o. b. Niagara Falls, N. Y., or Bridgeville, Pa., freight allowed to destination for 25 pounds or over:

A—Open Hearth, minimum 30 percent V. (Trade journal quotations specify a minimum 35-percent vanadium content).....	\$2. 70
B—Crucible, minimum 35 percent V.....	2. 80
C—Primos, minimum 35 percent V.....	2. 90
Spot prices, 10 cents per pound higher.	

Vanadium pentoxide.—Per pound of contained V_2O_5 , air-dried or fused vanadium pentoxide, f. o. b. Niagara Falls, N. Y., or Bridgeville, Pa., with freight allowed to destination on 25 pounds or over:

(1) Maximum base contract price, any quantity.....	\$1. 10
(2) Maximum base spot price:	
500 pounds and over.....	1. 15
Less than 500 pounds to 10 pounds.....	1. 20
Under 10 pounds.....	1. 25

Vanadium is also marketed in the form of special alloys, such as the Grainal series. Grainal No. 1, containing 25 percent vanadium, is quoted at 87.5 cents per pound of alloy, and Grainal No. 6, containing 13 percent vanadium, at 60 cents per pound.

MINE PRODUCTION AND TREATMENT OF ORES

The termination of the Metals Reserve Company domestic vanadium ore-purchasing program on February 29, 1944, was the outstanding event in the industry in the United States during the year. Removal of the price incentive and ready market for marginal ores caused many small independent operators to cease mining vanadium ores. In contrast to the 216 operators who reported production in 1943, only 82 are known to have shipped in 1944, and more than half of these shipped to the Metals Reserve Company only during the first 2 months of the year. Many of the producers of 1942 and 1943 who had mined as individuals or as members of family groups entered the armed forces, and production from their claims ceased.

The responsibility for maintaining a domestic vanadium-mining industry therefore reverted to the two major producers—United States Vanadium Corp. and Vanadium Corp. of America. Their operations, through mining, leasing, and purchasing from small operators, extended over the Southwest Colorado-Southwest Utah and Northeast Arizona-Northwest New Mexico area. Some of the miners who had formerly sold to Metals Reserve Company marketed their vanadium ores to the large mill operators, but others found it impracticable to meet the higher ore specifications and lower prices offered by industry.

The United States Vanadium Corp. and Vanadium Corp. of America, which had acted as agents for Metals Reserve Company during the domestic purchase program, gradually severed their connections, as purchasers and refiners, and by the end of 1944 mining and milling operations were largely for private account.

The United States Vanadium Corp. acted as agent for Metals Reserve Company in purchasing domestic vanadium ores from July 1942 until the end of February 1944. The Government-owned ores were milled by United States Vanadium Corp. at the Defense Plant Corporation plant at Durango, Colo., and at the Nisley & Wilson mill at Gateway, Colo., and by Vanadium Corp. of America at Monticello, Utah. Operation of these mills on behalf of the Government was suspended in the spring of 1944, but in October the United States Vanadium Corp. purchased the Durango mill and began treating the Metals Reserve Company stock pile at Durango on a toll basis. Early in 1945 the Vanadium Corp. of America purchased the Monticello stock pile and leased the Defense Plant Corporation plant there. The Gateway stock pile was sold to United States Vanadium Corp. and moved to the mill location at Uravan. By the end of March 1945 all domestic vanadium ores purchased by Metals Reserve Company had been disposed of except the untreated remainder of the Durango stock pile and a small stock of Nevada lead vanadate ore and concentrates.

The following excerpt from the report of the Reconstruction Finance Corporation for the period June 28, 1940, to November 1, 1944,¹ is worthy of note:

Relative rank in dollar cost of deliveries.....	20
Cost of deliveries to MRC.....	\$6, 503, 284
Proceeds of sales.....	2, 467, 064
Inventory Oct. 31, 1944, at market value.....	3, 542, 565

REVIEW BY STATES

Arizona-New Mexico.—Vanadium mining in this southern portion of the four-States area in 1944 consisted largely of lessee operations of Vanadium Corp. of America and mining by Wade, Curran & Co. on the Apache Reservation in the Carrizo Mountains.

The recovery of vanadium from complex ores at Tiger, Ariz., and the production of sodium vanadate by Mammoth-St. Anthony, Ltd., were suspended in the summer of 1944. The recovery process employed by the company was described in *Mining World*.² Announced program of the company to discontinue temporarily the production of vanadium, molybdenum, and gold, in order to use entire mill facilities for the production of lead and zinc, was thwarted in September when fire destroyed the Mohawk shaft and part of the surface plant. By concentrated effort 700 feet of the shaft was retimbered in 40 working days.⁴

Colorado.—In 1944, Colorado was again the leading producer of vanadium ores. The largest single vanadium property, at Rifle Creek, was worked by the United States Vanadium Corp. The area was examined and mapped by the Geological Survey in the summer of 1944, and a preliminary report and map were issued in December of that year. The following paragraphs are quoted from the report:⁵

Vanadium ore is being mined from two deposits in the Entrada sandstone, at the Rifle and Garfield mines, about 13 miles northeast of Rifle, Garfield County, Colo. The deposit at the Rifle mine has been the most productive of the vanadium-bearing sandstone type of deposit. It was mined from 1925 to 1932, and the current period of mining began in 1941. The Garfield mine was operated at intervals before 1942 and has been in continuous operation since that time. Small deposits of vanadium ore have also been mined from the Morrison formation in the area shown on the map and in the adjoining area to the east. The total production of vanadium ore from all of these deposits is about 500,000 tons. * * *

Conclusions.—The present knowledge of the deposits in the Entrada sandstone suggests that the close association of the deposits with the thicker part of the altered zone at the top of the "Red Beds," and the special relationship of the ore bodies in one unit of the Entrada to those in the other, appear to be the only positive guides in searching for new ore bodies. The deposits in the Morrison are confined to the lower part of the formation, but the location of undiscovered ore bodies within these beds cannot be predicted. The genesis of the deposits and the controls that localized the ore are not definitely determined, and all of the evidence concerning them cannot be presented in a brief statement.

The greater part of the domestic vanadium ore milled for private account was treated at the United States Vanadium Corp. mill at Rifle. The present 200-ton mill was reconstructed from one used

¹ Includes foreign purchases.

² *Mining World*, Unusual Metallurgy—Mammoth-St. Anthony, Ltd., Arizona: Vol. 6, No. 9, September 1944, pp. 23-27.

³ *Engineering and Mining Journal*, Fast Work Retimbering Burned-Out Shaft: Vol. 145, No. 12, December 1944, p. 92.

⁴ Fischer, R. P., Stokes, W. L., and Smith, L. E., *Geology of the Rifle Creek Vanadium Area, Garfield County, Colo.*—Preliminary Report: Geological Survey, December 1944, 5 pp.

during the earlier period of operation (1925-32); production was resumed in February 1942.⁶⁷

The smaller (100-ton) mill at Durango was built in 1942 largely from materials remaining from a plant originally constructed in 1881.⁸ The mill was operated for Metals Reserve Company by United States Vanadium Corp. from August 1942 until early 1944, when all but the acid leaching plant for treatment of tailings was closed. The mill was purchased by United States Vanadium Corp., and treatment of vanadium ores (virtually all from the Durango stock pile) was resumed on a contract basis in October 1944.

The 75-ton mill of Vanadium Corp. at Naturita operated continuously throughout the year.

At Uravan, Colo., the 300-ton mill used by United States Vanadium Corp. for its own milling operations was inactive during most of the year. Improved recoveries are said to have been obtained from a new filter design at the mill.⁹

The North Continent Mines, Inc., which had operated at Slick Rock, San Miguel County, for about 10 years, closed its 20-ton mill at the end of 1944, and subsequent announcement was made of approval by the Securities and Exchange Commission of the sale of the mine, mill, and equipment to the Union Mines Development Corp.¹⁰

*New York.*¹¹—The possible recovery of vanadium from titaniferous magnetites of the Adirondacks continues to be of interest but has not yet been undertaken commercially. Preliminary work has been performed by the National Lead Co. in reopening old workings on Sanford Hill, and Bethlehem Steel Co. has investigated the recovery of vanadium from slag from pig iron reduced from the magnetite sinter.

The accompanying table shows total production by the major and smaller producers, by States. Owing to the difficulty of obtaining reports from all vanadium miners, many of whom are transients, mine production is reported here in terms of receipts at processing plants and purchasing depots.

Vanadium ores and concentrates produced in the United States in 1944, by States in pounds of V₂O₅ contained

State	Pounds	Value ¹
Colorado.....	5,462,012	(²)
Utah.....	512,581	\$261,765
Other ³	323,717	139,487
	6,298,310	(²)

¹ Partly estimated.

² Includes previously worked material, received for retreatment, to which no value has been assigned.

³ Bureau of Mines not at liberty to publish figure.

⁴ Arizona, Idaho, and New Mexico.

⁵ Mining World, War-Born Innovations Prove Valuable at the Rifle Mill: Vol. 6, No. 3, March 1944, pp. 43-44.

⁶ Mining World, Vanadium Mining at Rifle, Colo.: Vol. 6, No. 6, June 1944, pp. 30-31, 34.

⁷ Mining World, War Plant from Scrap Pile: Vol. 6, No. 4, April 1944, pp. 14-16.

⁸ Ramsey, Robert H., How a New Filter Design Raised Vanadium Output: Eng. and Min. Jour., vol. 145, No. 7, July 1944, pp. 78-81.

⁹ Mining Journal (Arizona), vol. 28, No. 22, Apr. 15, 1945, p. 22.

¹⁰ Oliver, Frank J., Large-Scale Working of Adirondack Magnetites: Iron Age, vol. 155, No. 4, Jan. 25, 1946, pp. 50-55.

Although the greater part of the vanadium oxide produced in the United States comes from domestic vanadium ores, additional quantities are recovered from phosphate rock mined in Idaho, from imported ores and concentrates treated at Bridgeville, Pa., and as a byproduct at Glens Falls, N. Y.

EXPLORATION AND DEVELOPMENT

Four exploration projects on showings of vanadium have been described in a recent report of the Bureau of Mines.¹²

Reserves totaling more than 20 million tons averaging about 1 percent V_2O_5 were shown at the following localities:

Ashland Vanadium, Clay, Coosa, and Chilton Counties, Ala.

Started: July 1943.

Exploration: 2,500 ft. of diamond drilling and trenching.

Reserves: 5,076,000 tons ± 0.10 percent V_2O_5 .

Remarks: Working on recovery of the vanadium from the schist. No further development planned.

Southwest Colorado and Southeast Utah.

Started: May 1943. Finished: December 1943.

Exploration: 38,598 ft. of diamond drilling and sampling.

Reserves: 40,000 tons 1.25 percent V_2O_5 .

Remarks: Auxiliary reserve of vanadium ore.

Mercur Dome, Tooele County, Utah.

Started: September 1943. Finished: November 1943.

Exploration: 300 ft. diamond drilling, 68 ft. hand auger, and workings sampled.

Reserves: 4,600 tons 0.717 percent V_2O_5 .

Remarks: The vanadiferous shale bed probably covers an area of several square miles, and the thickness is about 5 ft. Metallurgical tests indicate that extraction of V_2O_5 will be difficult.

Southwest Wyoming—Lincoln County, Wyo.

Started: July 1943. Finished: December 1943.

Exploration: 90 trenches dug along 20 miles of outcrops; 7 adits driven for a distance of 544 ft.; 4 shafts sunk along fault for a total of 110 ft.

Reserves: 18 million to 25 million tons, 0.90 to 1.0 percent V_2O_5 .

Remarks: The vanadium occurs in thin shale beds within the Phosphoria formation. The vanadium-bearing shales are about 3 ft. thick and appear to be continuous over the area.

The Bureau's work on treating vanadium-bearing materials from various domestic sources has been described in an article by Johnson and Davis,¹³ from which the following excerpts are taken:

Dry differential grinding of carnotites from Colorado and Arizona (containing 2.3 to 4.7 percent V_2O_5) followed by air separation effected recoveries from 70 to 78 percent at a concentration ratio of 3 to 1 and in one case 86.3 percent at a $2\frac{1}{2}$: 1 ratio.

Flotation tests on a Nevada ore containing 1.7 percent V_2O_5 , chiefly as cuprodescoizite, showed that concentrates with 8.82 percent V_2O_5 can be made with 88 percent recovery of the vanadium.

A vanadinite ore from Arizona assaying 0.35 percent V_2O_5 proved susceptible to flotation. A concentrate containing 15.4 percent V_2O_5 and 59.7 percent Pb was produced by standard procedure, with recoveries of 75 and 92.3 percent, respectively * * *.

The * * * refractory nature [of the low-grade ore of the Idaho-Wyoming vanadium area] poses a difficult metallurgical problem, which is being investigated in the Bureau laboratories at Salt Lake City. It has been found that about 85 percent of the vanadium and phosphorus can be extracted by roasting the ore with salt (NaCl) and pyrite. The roasted residue is water-leached, which dissolves most of the vanadium; then leached with sulfuric acid, which removes

¹² Jullihn, C. E., and Moon, Lowell B., Summary of Bureau of Mines Exploration Projects on Deposits of Raw Material Resources for Steel Production: Bureau of Mines Rept. of Investigations 3801, 1945, pp. 32-33, 35.

¹³ Johnson, A. C. and Davis, C. W., War Development Proves Large Vanadium Reserves: Eng. and Min. Jour., vol. 146, No. 4, April 1945, pp. 105-107.

most of the phosphorus. Two products, one high in vanadium and the other suitable for use as a phosphate fertilizer, have been thus recovered. * * *

The Bureau has recently discovered vanadium associated with greenish mica that forms an important constituent of the graphite ores occurring near Ashland, Ala., which may be an important source. The little metallurgical research done indicates that a concentrate containing 0.5 percent V_2O_5 can be obtained as a byproduct of the local graphite operations. Possibly the concentrate grade can be increased. * * *

* * * The most feasible method [of recovering vanadium from titaniferous magnetites occurring in New York] appears to be to recover the vanadium in pig iron, which could be blown in a converter to produce a slag with enough vanadium for the production of ferrovanadium in another furnace operation. Tests in an experimental blast furnace at the Bureau's Minneapolis station indicate that 87 percent of the vanadium can be recovered from the pig iron. Fairly satisfactory operating conditions were maintained as long as the titania content of the slag did not exceed 10 percent. * * *

The Geological Survey continued investigations of vanadium deposits in the sandstones of the Colorado Plateau region of Colorado, Utah, Arizona, and New Mexico and released an excellent geologic map of the vanadium region of Southwest Colorado and Southeast Utah. Additional geologic work was done in the Thompsons (Utah) and Gateway (Colo.) districts; maps of these areas will be issued in 1945. The Rifle (Colo.) area was mapped, and a map and short text were released. A report on vanadium in the phosphatic shales of Idaho and Wyoming is in preparation.

FOREIGN TRADE ¹⁴

Vanadium is imported into the United States as ore, concentrates, and flue dust. In 1944, all imports of vanadium ore or concentrates were from Peru. As most of the imports were in the form of concentrates, the average vanadium content of the material was appreciably higher than in the previous year. Vanadium-bearing flue dust comprises a small part of the import total. However, additional quantities of vanadium are recovered in the United States from flue dust and boiler scale from ships burning Venezuelan oils.

Vanadium ore or concentrates and vanadium-bearing flue dust imported for consumption in the United States, 1943-44, by countries

Country	1943			1944		
	Pounds		Value	Pounds		Value
	Gross weight	Vanadium content		Gross weight	Vanadium content	
Ore or concentrates:						
Peru.....	18,361,988	1,559,160	\$816,401	4,247,490	1,284,603	\$633,719
South-West Africa ¹	3,755,143	493,460	263,749			
	22,117,131	2,052,620	1,080,150	4,247,490	1,284,603	633,719
Vanadium-bearing flue dust:						
Curacao (N. W. I.).....	596,246	57,481	48,148	169,274	36,370	24,695
Peru.....	152,503	6,912	5,405			
Venezuela.....				22,627	3,801	3,364
	748,749	64,393	53,553	191,901	40,171	28,059

¹ Reported by the U. S. Department of Commerce as Union of South Africa.

¹⁴ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Vanadium ore or concentrates imported for consumption in the United States, 1935-44

Year	Pounds		Value	Year	Pounds		Value
	Gross weight	Vanadium content			Gross weight	Vanadium content	
1935.....	952,000	94,080	\$40,070	1940.....	45,102,004	2,574,951	\$1,216,705
1936.....	3,734,080	342,720	155,730	1941.....	24,645,686	2,133,608	1,012,991
1937.....	14,806,400	1,258,880	638,799	1942.....	36,492,268	2,422,376	1,274,483
1938.....	19,962,880	1,384,320	891,475	1943.....	22,117,131	2,052,620	1,080,150
1939.....	31,357,722	2,132,548	991,511	1944.....	4,247,490	1,284,603	633,719

Exports of vanadium ore and concentrates are very small. Most shipments to foreign countries are in the form of ferrovanadium; a small quantity of vanadium oxide (33,084 pounds in 1944) is also exported. Exports of ferrovanadium were 1,191,996 pounds, valued at \$2,212,490, in 1944 compared with 444,457 pounds, valued at \$518,322, in 1943. Most of the ferrovanadium shipped in 1944 went to the U. S. S. R.

Vanadium ore and concentrates¹ exported from the United States, 1942-44, by countries, in pounds

Country	1942		1943		1944	
	Gross weight	Vanadium content	Gross weight	Vanadium content	Gross weight	Vanadium content
Australia.....			5,160	1,445		
Canada.....	73,542	22,140	75,438	26,186	6,390	2,201
India and Dependencies.....					9,878	4,053
Iran.....			37,676	10,549		
	73,542	22,140	118,274	38,180	16,268	6,254

¹ Classed as ore and concentrates but probably also includes fused vanadium oxide.

WORLD PRODUCTION AND DEVELOPMENTS

Complete information on vanadium production in 1944 is not available, but preliminary figures indicate a world output near that of 1941. Production by the three principal producing countries—the United States, Peru, and South-West Africa—was at about two-thirds of the 1943 rate. No information is available with respect to production of vanadium in Northern Rhodesia during 1944.

World production of vanadium in ores and concentrates, 1938-44, in metric tons

[Compiled by B. B. Waldbauer]

Country	1938	1939	1940	1941	1942	1943	1944
Argentina.....		15	1	6			(¹)
Mexico.....	101	80	32	(²)			
Northern Rhodesia.....	374	384	368	342	350	375	(¹)
Peru.....	826	996	1,214	1,017	1,015	855	616
South-West Africa.....	557	514	428	269	453	577	385
United States (shipments).....	732	900	981	1,140	2,014	2,534	1,600
	2,590	2,890	3,020	2,800	4,300	4,400	(¹)

¹ Data not available.

² Less than 1 ton.

³ Estimated by authors.

⁴ Preliminary.

Argentina.—Discovery of vanadium deposits near San Rafael was reported at the First Industrial Mining Congress in San Juan, Argentina. The ore is said to contain 8 to 10 percent V_2O_5 .¹⁵

Canada.—Further information concerning the occurrence of vanadium on Quadra Island, about 100 miles north of Vancouver, has been made public.¹⁶ Although this and other small deposits in the vicinity have not proved to be commercially important, their existence has been cited as a guide to the possible discovery of other richer sources.

Germany.—German requirements for vanadium, reported as 660,000 to 880,000 pounds in the form of ferrovanadium,¹⁷ in 1937, were formerly met from imported materials, such as Otavi ores from South-West Africa and vanadium slags of the Christiania-Spigerverk, Norway. In addition, vanadium was recovered in Germany from minette ores of France and Luxemburg as well as from iron ores mined in Germany itself. Vanadium-bearing flue dust and possibly red mud from the Bayer alumina process have provided auxiliary sources. Territorial losses during 1944 no doubt cut deeply into Germany's vanadium resources. It is not known to what extent Swedish iron ores continued to be available to Germany, but one estimate¹⁸ has placed a theoretical recovery of vanadium at 500 tons, if Swedish ores were used exclusively in Bessemer plants.

The following notes on the use of vanadium in German matériel are abstracted from a metallurgical study of enemy ordnance, published in Metal Progress.¹⁹

Great variability was shown in the use of molybdenum and vanadium in projectiles. * * * Vanadium was either absent, or at anything up to 0.20 percent; sometimes this amount of vanadium and an appreciable amount of nickel were present together. * * * The same shell might have vanadium but no molybdenum in the cap; no molybdenum or vanadium in the tip; and 0.20 percent molybdenum but no vanadium, or both molybdenum and vanadium in the base—or any other combination. It seems as though the Germans liked to use molybdenum or vanadium, and perhaps would prefer both together, and used them when they were available, but got along without them when they were not. * * * The use of vanadium in these projectiles is spotty. Some iron ores which have been available to the Germans carry small amounts of vanadium, most of which is recovered from the pig iron by slagging off in a converter or mixer. The vanadium is recovered from the slag by special methods that must make the metal very expensive in man-hours. The supply of vanadium from this source probably fluctuates, and this fluctuation may account for the erratic way in which it appears or fails to appear in the finished steel. When it does appear it is often in a surprisingly high amount for the type of steel under study. * * * The general use of molybdenum in what we would term high proportions and the occasional lavish use of vanadium suggest that the Germans have very adequate supplies or stockpiles of tungsten for high-speed tool steels and carbide tools.

*India.*²⁰—Vanadium is not known to be produced in India, but deposits of vanadium-bearing titaniferous iron ores occur in Singhbhum and adjacent parts of Mayurbhanj. The vanadium content is said to be as high as 4 percent (V_2O_5 ?) and reserves are placed at between 2,000,000 and 3,000,000 tons. Vanadium recovery from these ores is being investigated.

¹⁵ Foreign Commerce Weekly, vol. 15, No. 6, May 6, 1944, p. 27.

¹⁶ Gunning, H. C., and Carlisle, Donald, Vanadium on the West Coast of British Columbia: Western Miner, vol. 17, No. 10, October 1944, pp. 39-43.

¹⁷ Zieler, H., Stahl u. Eisen, vol. 58, 1938, pp. 749-756.

¹⁸ Metal Bulletin (London), Swedish Ore for Germany: No. 2875, Mar. 7, 1944, p. 12.

¹⁹ Cady, J. R., Gillett, H. W., and Grenell, L. H. (Battelle Memorial Institute), Enemy Matériel from the Metallurgical Point of View (Report to War Metallurgy Committee): Metal Progress, vol. 47, No. 2, February 1945, pp. 289-320.

²⁰ Metal Bulletin (London), India's Mineral Industry: No. 2910, July 14, 1944, pp. 4-5, 10.

Northern Rhodesia.—Production of fused vanadic oxide by the Rhodesia Broken Hill Development Co. "proceeded satisfactorily" throughout 1943, according to the annual report of the company.

Peru.—Until surpassed by the United States in 1941, Peru was the leading vanadium-producing country of the world. The famed Mina Ragra property of the Vanadium Corp. of America, high in the Andes, has been an important source of vanadium for many years. As supplies of high-grade shipping ore diminished, an increasing proportion of shipments has been in the form of concentrates. Completion of a 200-ton plant for the production of "red cake" was retarded by labor shortages, and although reported to be virtually complete in October its operation had not commenced at the end of 1944.

*Sweden.*²¹—Considerable effort has been directed toward the development of vanadium and other alloy-metal resources in Sweden. A small percentage of vanadium is present in low-grade titaniferous iron ore at the Smaland Taberg mine in Jönköping County, which was reopened following a long period of idleness. In 1943, the Södra Ulvön mine (Västernorrland County) was expected to produce 100,000 tons of titaniferous iron ore having a vanadium content of 0.4 percent. Vanadium is also present in oil shales that are being exploited. The discovery of a deposit of vanadium ore has been reported at Vaedungsfjället, not far from the Norwegian border, in Jämtland County.

U. S. S. R.—According to a paper by A. P. Vinogradov,²² presented before the Russian Academy of Sciences in May 1944, a semicommercial plant is producing ferrovanadium from asphalt obtained from Ural petroleum. As much as 43 percent vanadium is said to be present in the ash.

²¹ Donogh, R. P., and Stough, D. B., Sweden's Unique Iron-Ore Position: Foreign Commerce Weekly, vol. 19, No. 2, Jan. 6, 1945, pp. 4-8, 42-46.

²² Chemical Industries, Vanadium Source: Vol. 56, No. 2, February 1945, p. 279.

TUNGSTEN

By HUBERT W. DAVIS

SUMMARY OUTLINE

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SUMMARY

The status of tungsten has shifted from a material insufficient to meet requirements to one in adequate supply, and throughout 1944 tungsten ore and concentrates, ferrotungsten, and most tungsten products were free from allocation control by the War Production Board. Because of the improved supply position the Metals Reserve Company on April 30, 1944, discontinued its premium price for domestic tungsten and suspended operations at the Salt Lake City (Utah) re-treatment plant. This action was followed by the closing of a number of mines. There was also a reduction in operations of two of the largest producers. Chiefly for these reasons the 4-year uninterrupted gain in production, which reached an all-time high of 12,055 tons of 60 percent WO_3 (revised figure) in 1943, declined to 10,259 tons in 1944. Production was maintained at the high monthly rate of about 1,200 tons during the first 4 months of 1944; in fact, nearly half of the total output in 1944 was produced during this period. Thereafter, monthly production declined almost uninterruptedly, and in December 1944 it had dropped to about 400 tons. The Yellow Pine mine in Idaho retained first place as a producer of tungsten concentrates in 1944. The importance of large mining and milling units in the tungsten industry is shown by the fact that four operators, each producing over 1,000 tons, supplied 72 percent of the entire output in 1944. Domestic production was equivalent to only 51 percent of United States consumption in 1944.

Receipts of imported ore and concentrates were 19,164 short tons (60 percent WO_3 basis) in 1944, a decline of 2 percent from the all-time record of 1943. Supplying 50.5 percent of the total, Bolivia was the chief source of imports in 1944. Argentina (12.4 percent), Brazil (11.7 percent), and China (19.4 percent) supplied most of the remainder.

Consumption of tungsten concentrates in 1944, amounting to 20,100 short tons (60 percent WO_3 basis), was only slightly less than in the peak year 1943.

The supplies of tungsten ore and concentrates made available in 1944 again greatly exceeded requirements; as a result, stocks (including secondary concentrates and milling ore) were 43 percent greater at the close of 1944 than at the end of 1943. Moreover, stocks at the end of 1944 equaled about 1½ years' requirements at the rate of consumption in 1944.

Statistical statistics of tungsten ore and concentrates in the United States, 1940-44, in pounds of tungsten

Year	Production ¹	Shipments from mines ¹	General imports (receipts)	Consumption	Stocks at end of year			
					Consumers and brokers	Producers ¹	Government stock pile ²	Total
40...	4,572,806	5,062,199	9,666,228	9,955,000	2,803,249	93,618	5,417,000	8,313,867
41...	6,420,303	6,249,945	13,152,716	16,699,000	2,404,876	263,626	8,117,000	10,785,502
42...	8,977,575	8,882,403	15,409,814	17,389,000	3,416,438	355,864	9,532,000	13,304,302
43...	11,472,985	11,368,295	18,678,426	19,313,000	2,459,246	458,586	21,058,000	23,975,832
44...	9,763,695	9,785,585	18,238,897	19,165,000	1,510,419	435,634	31,867,000	33,813,053

¹ Primary concentrates.

² Stocks for 1940-43 comprise primary concentrates only; those for 1944 comprise primary and secondary concentrates and milling ore.

³ Revised figures.

Figure 1 shows trends in domestic shipments, imports, and prices of tungsten ore and concentrates since 1915.

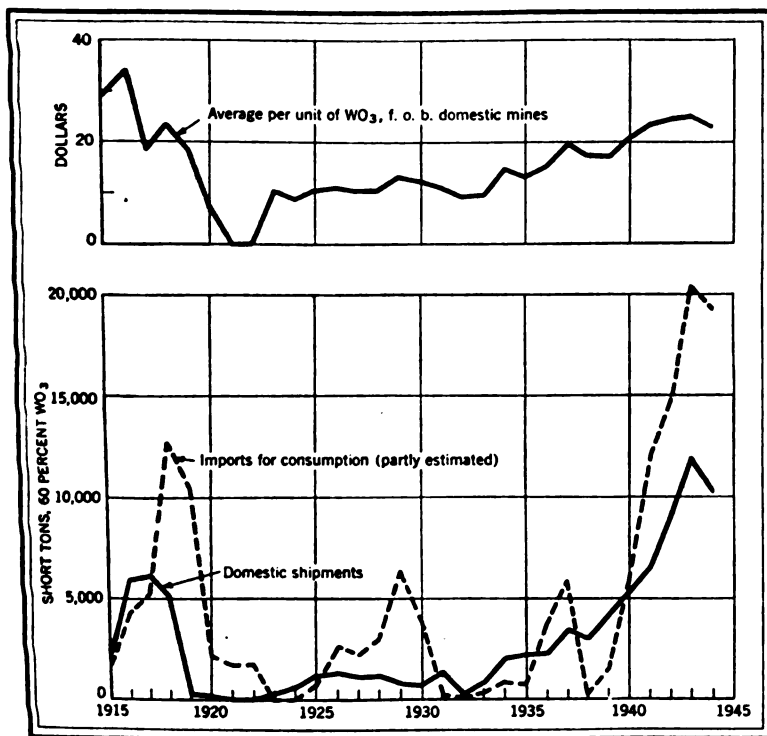


FIGURE 1.—Trends in domestic shipments, imports, and average price of tungsten ore and concentrates, 1915-44.

POSTWAR OUTLOOK

When the need arose in 1941 to conserve tungsten in alloy steels, it was displaced to a substantial extent by molybdenum. However, upon removal of the restrictions on the use of tungsten on December 30, 1943, the result was an immediate swing back to prewar metallurgy for tool steel compositions. According to Spaulding,¹ "Tungsten high-speed steel, which had been largely replaced by molybdenum types, came rapidly back into favor until in a few months the molybdenum high-speed steels were again in the minority position."

Nevertheless, molybdenum-type steel, especially the so-called "6-6" (6 percent molybdenum and 6 percent tungsten) tool steel, will undoubtedly retain certain of its gains. According to Allen:²

Under the lead of the three largest motor companies, a plan has been developed to standardize on the 6-6 or molybdenum-type high-speed steel for the bulk of tool requirements, instead of the former 18-4-1 (18 percent tungsten, 4 percent chromium, and 1 percent vanadium) type. Basic reasons for the standardization are economic, the 6-6 steel being about 10 cents a pound less costly than the 18-4-1

Molybdenum-type tool steels, however, have to be especially heat treated, and many of the smaller users do not have the facilities for doing this. These consumers therefore will revert to using tungsten-type tool steels.

The use of tungsten carbide and of stellite (a cobalt-chromium-tungsten alloy) for cutting tools, which increased rapidly during the war, is expected to continue to develop.

In general, although no new uses applicable to peacetime were developed for tungsten during the war, its properties are so unusual that it is expected to recover most of its peacetime applications after the war and to expand steadily in use.

To what extent the United States will supply its needs for tungsten after the war will, of course, depend much upon the price. Stimulated by increased needs and higher prices, domestic production gained phenomenally during the war. However, upon withdrawal of the premium price paid to certain producers by the Metals Reserve Company, the high-cost operating mines were closed. Nevertheless, certain well-equipped domestic mines are likely to continue producing after V-J day, and their combined output should make the United States less dependent on foreign ores than before the war, provided of course that the present duty is not substantially reduced. Despite the duty, however, postwar domestic production, as in the past, will probably be inadequate to meet home demands, and imports will be necessary. For several years before World War II, China and the Malay States were the chief sources of imports of tungsten into the United States; and economic factors, such as size of deposits, richness of ore, and production costs, favor these countries to regain their prewar market in this country. With regard to South America, where production was increased greatly in World War II as in World War I, it is likely that the postwar output will follow the pattern after World War I and decline substantially. Nevertheless, more South American mines probably will be capable of producing tungsten at the world price after World War II than after World War I.

¹ Spaulding, S. C., *Tool and Die Steels: Metals and Alloys*, vol. 21, No. 1, January 1945, p. 87.

² Allen, A. H., *Mirrors of Motordom: Steel*, vol. 115, No. 19, Nov. 6, 1944, p. 93.

GOVERNMENT EXPLORATION

In 1944 the Geological Survey investigated and mapped about 150 tungsten deposits in the United States, including revisits to operating properties previously mapped. Tungsten deposits were also examined by Survey geologists in Mexico. The Bureau of Mines continued its exploration program on tungsten deposits in the United States.

PRICES

Throughout 1944 quotations on imported tungsten ore and concentrates remained steady, but the price trend of domestic concentrates was downward. According to the Engineering and Mining Journal, Chinese, Bolivian, and Portuguese ore was quoted at \$24 a short-ton unit of WO_3 , duty paid; the price of domestic scheelite of good known analysis, in carlots, delivered, was \$26 a unit at the beginning of 1944 and was lowered to \$25 on May 25, to \$25.00–\$24.50 on August 31, to \$25.00–\$24.00 on September 14, and to \$24.50–\$24.00 on November 23. The average price for the domestic primary concentrates shipped in 1944, as reported to the Bureau of Mines, was \$23.36 a short-ton unit of WO_3 .

DOMESTIC PRODUCTION

The tungsten ores mined and milled in the United States, in general, contain 0.5 to 2.5 percent WO_3 and are beneficiated to a concentrate containing 60 percent or more WO_3 . Scheelite (calcium tungstate) is the tungsten mineral in most domestic ore mined. The three leading tungsten producers (66 percent of the United States total in 1944) and many small operators depend on ore carrying tungsten only as scheelite. Ferberite (iron tungstate), hübnerite (manganese tungstate), and wolframite (iron-manganese tungstate), in the order listed, contribute a comparatively small part of the tungsten in domestic ores. Most of the concentrates are converted to ferrotungsten and tungsten metal. Some high-purity scheelite concentrates, however, are charged directly to the steel bath. Wolframite is preferred for the filament in electric light bulbs.

The 4-year upward trend in production, which reached an all-time high of 12,055 (revised figure) short tons (60 percent WO_3 basis) of primary concentrates in 1943, turned downward to 10,259 tons in 1944. Although the concentrates were obtained from a large number of widely scattered operations in 12 States and Alaska, three States—California, Idaho, and Nevada—supplied 94 percent of the total, and four operators (United States Vanadium Corp., Bradley Mining Co., Nevada-Massachusetts Co., and Metals Reserve Company) produced 72 percent of the United States total. Idaho retained first place as the principal producing State, and the Bradley Mining Co. was again the chief operator.

In addition to the output of 10,259 tons of primary concentrates, 3,593 tons of secondary concentrates (15.53 percent WO_3), which require further milling, and some milling ore were produced in 1944. The bulk of these concentrates was shipped to the re-treatment plant of Metals Reserve Company at Salt Lake City, Utah; the ore was shipped to the re-treatment plant and to various purchasing depots of Metals Reserve Company. Some of the secondary concentrates shipped to the re-treatment plant in 1942, 1943, and 1944 were

treated during 1944, and the resultant primary concentrates recovered in 1944 are included in the production and shipment figures.

*Tungsten ore and concentrates produced and shipped in the United States, 1943-44 by States*¹

State	Produced				Shipped from mines			
	1943		1944		1943		1944	
	Short tons, 60 per cent WO ₃	Units	Short tons, 60 per cent WO ₃	Units	Short tons, 60 per cent WO ₃	Units	Short tons, 60 per cent WO ₃	Units
Alaska.....	10	627	19	1,111	10	627	19	1,111
Arizona.....	55	3,302	24	1,439	62	3,724	29	1,738
California.....	3,867	232,011	2,978	178,705	3,871	232,238	3,027	181,647
Colorado.....	342	20,522	299	17,955	378	22,693	296	17,749
Idaho.....	4,878	292,673	3,957	237,434	4,648	278,885	4,005	240,287
Missouri.....	1	45	1	62	1	45	1	62
Montana.....	13	815	16	981			25	1,529
Nevada.....	2,819	169,139	2,747	164,796	2,910	174,619	2,665	159,924
New Mexico.....			9	496			9	496
North Carolina.....	47	2,798	187	11,198	40	2,388	186	11,154
South Dakota.....			7	419			6	344
Utah.....	21	1,248	9	564	21	1,248	9	564
Washington.....	2	136	6	363	4	234	5	307
	12,055	723,316	10,259	615,523	11,945	716,701	10,282	616,912

¹ Excludes secondary concentrates and ore produced as mill feed for the Salt Lake City, Utah, mill of Metals Reserve Company and ore produced and shipped to depots of Metals Reserve Company. Instead, the primary concentrates produced at the Salt Lake City mill, as well as shipped, are included.

² Revised figures.

Tungsten ore and concentrates shipped from mines in the United States, 1940-44

Year	Quantity		Reported value f. o. b. mines		
	Ore and concentrates, 60 per cent WO ₃ (short tons)	Tungsten content (pounds)	Total	Average per unit of WO ₃	Average per pound of tungsten
1940.....	5,319	5,062,199	\$6,576,318	\$20.61	\$1.30
1941.....	6,567	6,249,945	9,223,726	23.41	1.48
1942.....	9,333	8,882,403	13,508,266	24.12	1.52
1943.....	11,945	11,368,295	17,973,685	25.08	1.58
1944.....	10,282	9,785,585	14,408,519	23.36	1.47

¹ Revised figures.

Alaska.—The Riverside mine near Hyder and the Stepovich mine near Fairbanks supplied the Alaskan production of tungsten in 1944. The Riverside mine produced 46 short tons of concentrates averaging 21.23 percent WO₃. These secondary concentrates, which were shipped to the re-treatment plant at Salt Lake City, Utah, for further treatment, are not included in the 1944 statistics. The low-grade concentrates produced at the Riverside mine in 1943 were remilled in 1944, and the tungsten values recovered are included in the 46 tons produced and shipped in 1944. Production at the Stepovich mine comprised 17 tons of primary concentrates averaging 64.27 percent WO₃ and 12 tons of secondary concentrates averaging 15.56 percent WO₃.

Arizona.—Production of primary tungsten concentrates in Arizona was 27 short tons averaging 53.3 percent WO₃ in 1944 compared with 60 tons averaging 55.03 percent WO₃ in 1943. Shipments were 32

sons averaging 54.31 percent WO_3 in 1944 and 65 tons averaging 57.29 percent WO_3 in 1943. The Black Gold and Las Guijas mines in Pima County, the Chloriding and Diff claims in Mohave County, the Maudina mine in Pinal County, and the Quartzite mine in Yuma County accounted for the bulk of the primary concentrates produced.

In addition to the primary tungsten concentrates produced and shipped in 1944, a small quantity of secondary concentrates was shipped to the re-treatment plant at Salt Lake City, Utah, and small quantities of milling ore were shipped to the Parker and Phoenix depots of Metals Reserve Company. The secondary concentrates and milling ore have been omitted from the 1944 statistics.

The tungsten deposits in the Boriana district and the Aquarius Range, Mohave County, have been described by Hobbs.³

California.—California again was the second-largest tungsten-producing State. Output of primary concentrates in 1944 was 2,912 short tons averaging 61 percent WO_3 compared with 3,559 tons averaging 65 percent WO_3 in 1943. Of the 1944 total, Inyo County supplied 68.7 percent; San Bernardino 11.7 percent; Tulare 7.5 percent; Madera 3.5 percent; and Fresno, Kern, Mono, and San Diego together 1.4 percent. The source of 7.2 percent was not reported, but the bulk came from Inyo and Tulare Counties.

Shipments of tungsten concentrates from California in 1944 totaled 2,940 short tons averaging 61.78 percent WO_3 compared with 3,569 tons averaging 65.07 percent WO_3 in 1943. The 1944 production and shipment figures include 106 tons of concentrates averaging 67.50 percent WO_3 , which were recovered at the Salt Lake City (Utah) re-treatment plant from the treatment of secondary concentrates originating in California, and 115 tons of concentrates averaging 45.28 percent WO_3 , which originated in California but were reshipped from the Salt Lake City plant without re-treatment. Although primary tungsten concentrates were shipped from a large number of widely scattered operations, five producers—United States Vanadium Corp. and Tungstar Corp. (in Inyo County), Hoefling Bros. (in San Bernardino County), Tulare County Tungsten Mines (in Tulare County), and Haggerty & Madden (in Madera County)—supplied 2,408 tons or 82 percent of the State total. The bulk of the remainder was shipped from the Salt Lake City plant; Tungsten Blue and Marble mines in Inyo County; Garnet Dike mine in Fresno County; and Harrel Hill mine in Tulare County.

In addition to the primary concentrates produced and shipped in 1944, 691 short tons of secondary concentrates averaging 16.63 percent WO_3 were shipped to the re-treatment plant at Salt Lake City for further treatment. A small quantity of milling ore was also shipped to the Salt Lake City plant, and small quantities of secondary concentrates and milling ore were shipped to the Fresno (Calif.) depot of Metals Reserve Company. The secondary concentrates and milling ore shipped to Salt Lake City and Fresno are not included in the 1944 statistics; instead, the resultant primary concentrates recovered are included.

The United States Vanadium Corp. continued to be the largest producer of primary concentrates in California. It operated the Pine Creek mine near Bishop and, in addition, treated some ore from the

³ Hobbs, S. W., *Tungsten Deposits in the Boriana District and the Aquarius Range, Mohave County, Ariz.*: Geol. Survey Bull. 940-I, 1944, 18 pp.

Adamson mine and some secondary concentrates from the Tungstar mine also near Bishop, the Yellow Pine mine in Idaho, and the Mill City mill in Nevada. The primary concentrates recovered from treating Yellow Pine and Mill City secondary concentrates have been credited in the statistics to Idaho and Nevada, respectively. Production of concentrates by the United States Vanadium Corp. was 35 percent less than in 1943.

The Tungstar mine near Bishop, operated by the Tungstar Corp. was the second largest producer in California in 1944. Production of primary and secondary concentrates was 65 percent more than in 1943. Sinking of a two-compartment shaft to 300 feet was in progress during 1944.

During 1944 Hoeft Bros. acquired the facilities of the Atolia Mining Co. to combine with its Spud Patch placer operation in San Bernardino County. Production of concentrates was 15 percent greater than in 1943.

The Atolia mine and mill in San Bernardino County, operated by the Atolia Mining Co.—the largest producer of tungsten concentrates during World War I—were shut down on March 20, 1944.

The Big Jim mine in Tulare County, operated by the Tulare County Tungsten Mines, produced at a greatly increased rate in 1944. Greater efficiency was attained by substituting electric power in the mill.

The Strawberry mine in Madera County, operated by Haggerty & Madden, produced 31 percent less concentrates than in 1943. A flotation unit was added to the mill in 1944.

Consolidated Tungsten, operating the Harrel Hill mine in Tulare County, produced 46 percent less concentrates than in 1943.

Colorado.—Production and shipments of primary concentrates (60 percent WO_3 basis) in Colorado were 299 and 296 short tons, respectively, in 1944 compared with 342 and 378 tons, respectively, in 1943. The 1944 production and shipment figures include 83 short tons of concentrates averaging 67.5 percent WO_3 , which were recovered at the Salt Lake City (Utah) re-treatment plant from the treatment of secondary concentrates originating in Colorado, and 25 tons of concentrates averaging 41.96 percent WO_3 , which originated in Colorado but were reshipped from the Salt Lake City plant without re-treatment.

In addition to the primary tungsten concentrates produced and shipped in 1944, Boulder Tungsten Mills (Inc.) and George H. Teal & Associates shipped 994 short tons of secondary concentrates averaging 6.85 percent WO_3 to the re-treatment plant of Metals Reserve Company at Salt Lake City, Utah, for further treatment. A substantial quantity of milling ore was shipped to the Nederland and Salida depots of Metals Reserve Company during 1944. These secondary concentrates and milling ore have been omitted from the 1944 statistics, but the resultant primary concentrates recovered are included.

Most of the primary tungsten concentrates produced in Colorado in 1944 came from operations of the Wolf Tongue Mining Co. and the Vanadium Corp. of America and from treating Colorado secondary concentrates at the Salt Lake City plant of Metals Reserve Company.

Idaho.—Idaho maintained its rank of leading producer of tungsten concentrates in the United States. However, production declined substantially in 1944 to 4,224 short tons averaging 56.21 percent WO_3 compared with 5,418 tons averaging 54.02 percent WO_3 in 1943. Shipments of primary concentrates in 1944 were 4,278 tons averaging

56.17 percent WO_3 compared with 5,186 tons averaging 53.78 percent WO_3 in 1943. The 1944 production and shipment figures include 558 tons of concentrates averaging 67.5 percent WO_3 , which were recovered at the Salt Lake City (Utah) plant from treating secondary concentrates originating at the Yellow Pine mine of Bradley Mining Co. The figures also include the concentrates recovered from treating Yellow Pine secondary concentrates at the plant of the United States Vanadium Corp. near Bishop, Calif.

The Yellow Pine mine near Stibnite, Valley County, operated by the Bradley Mining Co., was again the largest producer of tungsten concentrates in the United States. In 1944 it produced and treated 211,382 short tons of scheelite ore averaging 1.42 percent WO_3 , which yielded 3,428 tons of primary concentrates (53.60 percent WO_3) and 7,782 tons of secondary concentrates (8.40 percent WO_3). These secondary concentrates, which were shipped to the re-treatment plant at Salt Lake City, to the plant of the United States Vanadium Corp. near Bishop, Calif., and to the purification plant of the Bradley Mining Co. at Boise for further treatment, are not included in the 1944 statistics; instead, the resultant primary concentrates recovered are included. The Bradley Mining Co. completed a leaching plant at Boise for the purification of tungsten concentrates in 1944.

Production of hübnerite concentrates at the Ima mine in the Blue Wing district, Lemhi County, was 189 short tons (68.24 percent WO_3) in 1944 compared with 174 tons (60.53 percent WO_3) in 1943.

Missouri.—A small quantity of hübnerite (62 units of WO_3) was shipped from Madison County in 1944.

Montana.—The H. & H. Mines worked the gravel containing scheelite and gold in lower Henderson Creek near Hall, Granite County; 747 short tons of dredge concentrates averaging 1.7 percent WO_3 were treated, which yielded 15 tons of concentrates averaging 65 percent WO_3 .

Nevada.—Production and shipments of primary concentrates (reduced to an equivalent of 60 percent WO_3) were 2,747 and 2,665 short tons, respectively, in 1944 compared with 2,819 and 2,910 tons, respectively, in 1943. The 1944 production and shipment figures include 300 tons of concentrates averaging 67.5 percent WO_3 , which were recovered at the Salt Lake City (Utah) plant from treating Nevada secondary concentrates, chiefly from Getchell Mine Inc., and 100 tons of concentrates averaging 51.26 percent WO_3 , which originated in Nevada but were reshipped from the Salt Lake City plant without re-treatment. In addition, the concentrates recovered in California from treating Nevada secondary concentrates have been credited in the statistics to Nevada.

The Nevada-Massachusetts Co. and affiliated companies, operating mills at Mill City, Golconda, and Toulon, were the chief producers in Nevada in 1944, but output was 18 percent less than in 1943. The company Mill City mill, which was destroyed by fire on November 11, 1943, was rebuilt and began operating in 1944. Smaller but important producers of primary concentrates in 1944 were Nevada Scheelite, Inc., operating a mine of the same name in Mineral County; Tungsten Metals Corp., operating the Scheelite Chief, Oriole, Everitt, and Silver Bell mines, and the Cherry Creek Tungsten Mining Co., operating the Cherry Creek mine, all in White Pine County; and M. G. L. Mining Corp., operating the M. G. L. mine in Pershing County. The remaining production of primary concen-

trates in Nevada in 1944 came from a number of smaller operations, but the bulk was produced by Lincoln Mines, Inc., operating a mine of the same name in Lincoln County; Knowles Bros., operating the Star Tungsten mine, and Battle Creek Tungsten Co., operating the Battle Creek mine, both in Elko County; and the Gilded Age Mining Co., operating the Black Horse mine in White Pine County.

In addition to the primary tungsten concentrates produced and shipped in 1944, 1,814 tons of secondary concentrates averaging 19.88 percent WO_3 were shipped to the re-treatment plant at Salt Lake City, Utah, for further treatment. Much milling ore was also shipped to the Salt Lake City plant and to the Battle Mountain and Winnemucca depots of Metals Reserve Company. These secondary concentrates and milling ore have been omitted from the 1944 statistics, but the resultant primary concentrates are included. The bulk of these secondary concentrates was shipped from Getchell Mine, Inc. The remainder came chiefly from the Lincoln, Cherry Creek, Star Tungsten, and M. G. L. mines.

The flotation plant at Getchell Mine, Inc., treated 58,086 tons of ore averaging 0.59 percent WO_3 during 1944 and recovered 1,471 tons of concentrates averaging 17.75 percent WO_3 . The ore treated came from the company mines in Humboldt County and from the Richmond and Rose Creek mines in Humboldt and Pershing Counties, respectively, operated by W. C. Rigg, and the Riley mine in Humboldt County, operated by J. E. Riley. Tungsten mining and milling at Getchell Mine, Inc., were terminated on July 1 and June 20, 1944, respectively. The construction of a 200-ton concentrating mill, to be completed in March 1945 to treat ore from the Riley mine, was in progress in 1944.

New Mexico.—Alloy Metals, at its flotation mill near El Paso, Tex., recovered a small quantity of concentrates from ore mined at a property near Winston, Sierra County, N. Mex. A small quantity of milling ore was produced in New Mexico in 1944 and shipped to the Deming depot of Metals Reserve Company. This ore has been omitted from the 1944 statistics.

North Carolina.—Haile Mines, Inc., operating the Haile mines in Vance County, produced 321 tons of concentrates averaging about 35 percent WO_3 in 1944.

The tungsten deposits in Vance County have been described in some detail by Munds and others.⁴

South Dakota.—A small quantity of high-grade ore, produced by the Homestake Mining Co. in 1943, was shipped in 1944. The ore was produced at the Wasp No. 2 mine in Lawrence County. The O-F Exploration Co. recovered 2 tons of concentrates averaging about 50 percent WO_3 from a property near Keystone, Pennington County; no shipments were made, however.

Utah.—Production and shipments of high-grade tungsten concentrates in 1944 were each 10 short tons averaging 56 percent WO_3 , compared with 20 tons averaging 62 percent in 1943.

In addition to the tungsten concentrates produced and shipped in 1944, a substantial quantity of milling ore was shipped to the re-treatment plant at Salt Lake City for further treatment. This ore has been omitted from the 1944 statistics. Most of this ore was

⁴ Munds, W. H., Ewoldt, H. B., and Cohen, C. J., A Tungsten Find in North Carolina: Eng. and Min. Jour., vol. 145, No. 8, August 1944, pp. 80-81.

produced at the Desert mine in Juab County, Star Dust and Traction Lode mines in Tooele County, Lone Pine mine in Box Elder County, and Garnet mine in Beaver County.

The re-treatment plant of Metals Reserve Company at Salt Lake City suspended operations on April 30, 1944. During the 4 months it operated in 1944 it treated 6,870 tons of concentrates averaging 10.98 percent WO_3 . The plant feed comprised chiefly secondary concentrates from the Yellow Pine mine of Bradley Mining Co. The remainder was secondary concentrates from California, Colorado, and Nevada. The resultant primary concentrates produced and shipped during 1944 have been credited in the statistics to the State of origin. During 1944, 248 tons of concentrates averaging about 48 percent WO_3 , which had been shipped to the Salt Lake City plant for further milling, were reshipped without re-treatment; these concentrates originated in California, Colorado, Nevada, and Utah and have been credited in the statistics to the State of origin.

Washington.—Production and shipments of tungsten concentrates in Washington in 1944, were 5 and 4 short tons, respectively, averaging about 68 percent WO_3 , compared with 2 and 3 tons, respectively, in 1943. Output in 1944 came from the Deer Lake, Keith, and Germania mines.

FOREIGN TRADE ⁵

Domestic production is inadequate for requirements, and the United States imports both tungsten concentrates and products, chiefly the former. Receipts of imported ore and concentrates totaled 18,238,897 pounds (tungsten content), equivalent to 19,164 short tons of 60 percent WO_3 , in 1944, a slight decrease from the all-time record established in 1943. Although ore and concentrates were received from nine foreign countries in 1944, two—Bolivia (51 percent) and China (19 percent)—supplied 70 percent of the total.

Imports for consumption amounted to 18,396,284 pounds (tungsten content) in 1944, equivalent to 19,330 short tons of 60 percent WO_3 ; Bolivia, China, Argentina, and Brazil supplied 50, 20, 12, and 11 percent, respectively, of the total.

The duty on tungsten ore or concentrates is 50 cents per pound on the metallic tungsten contained therein. This is equivalent to \$7.93 per short ton unit.⁶

Exports of tungsten ore and concentrates from the United States are insignificant; none was exported in 1944 compared with 2,416 pounds in 1943.

Imports of tungstic acid were 21 pounds in 1944 compared with none in 1943. No tungsten metal, ferrotungsten, tungsten carbide, and other compounds of tungsten, or combination containing tungsten or tungsten carbide, were imported in 1943 and 1944.

Exports of metal, wire, shapes, and alloys other than ferrotungsten were 313,174 pounds in 1944 compared with 230,415 pounds in 1943. Exports of ferrotungsten were 2,353,340 pounds in 1944 compared with 1,032,649 pounds in 1943. Exports of sodium tungstate were 2,485 pounds in 1944 compared with 1,508 pounds in 1943. There were no exports of tungstic acid in 1944 compared with 51,703 pounds in 1943.

⁵ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

⁶ A unit, as applied to tungsten ores, is 1 percent of a ton of tungsten trioxide (WO_3). Thus, a short-ton unit is 20 pounds of WO_3 or 16.66 pounds of tungsten (W).

Tungsten ore and concentrates imported into the United States, 1943-44, by countries

Country	General imports ¹		Imports for consumption ²		
	Gross weight (pounds)	Tungsten content (pounds)	Gross weight (pounds)	Tungsten content (pounds)	Value
1943					
Argentina.....	4,058,560	2,083,677	4,498,352	2,335,090	\$3,241,636
Australia.....	11,107	6,997	11,107	6,997	7,796
Bolivia.....	11,187,440	5,037,184	11,290,625	5,097,315	6,448,778
Brazil.....	2,239,323	1,135,625	2,239,323	1,135,625	1,572,786
Burma.....			85,044	44,223	28,398
Canada.....	636,716	64,786	636,716	64,786	65,674
China.....	18,457,566	8,808,578	10,067,203	9,140,852	11,025,323
Cuba.....	13,376	7,892	13,376	7,892	8,814
India and Dependencies.....	302,960	168,194	302,960	168,194	235,360
Indochina, French.....	229,820	126,971	229,820	126,971	220,627
Mexico.....	1,653,959	351,700	607,909	323,129	350,744
Peru.....	1,074,942	553,868	1,084,148	559,104	736,924
Portugal.....	622,036	311,211	624,855	312,677	490,124
Thailand.....			188,793	104,188	91,331
Union of South Africa.....	22,100	11,743	32,481	17,974	19,823
	37,509,905	18,678,426	37,918,772	19,445,017	24,544,037
1944					
Argentina.....	4,321,724	2,266,856	4,321,724	2,266,856	3,171,621
Belgian Congo.....			45,565	25,543	26,849
Bolivia.....	³ 16,022,697	³ 7,458,324	³ 16,039,103	³ 7,466,885	³ 10,471,684
Brazil.....	4,387,310	2,141,350	4,214,038	2,045,499	2,662,045
Burma.....			157,568	78,890	77,780
Canada.....	996,960	226,815	899,040	170,900	172,783
Chile.....	4,264	2,900	4,264	2,900	2,300
China.....	6,214,458	3,534,964	6,388,559	3,626,221	5,193,870
India and Dependencies.....	162,660	90,720	162,660	90,720	138,800
Mexico.....	733,499	383,245	785,809	409,789	465,950
Peru.....	³ 5,066,525	³ 2,133,723	³ 5,075,215	³ 2,138,547	³ 2,285,585
Portugal.....			82,092	42,291	36,980
Union of South Africa.....			60,785	31,243	32,224
	37,910,097	18,238,897	38,236,422	18,396,284	24,736,471

¹ Comprises ore and concentrates received in the United States; part went into consumption during year and remainder entered bonded warehouses.

² Comprises ore and concentrates withdrawn from bonded warehouses during year (irrespective of time of importation) and receipts during year for consumption.

³ Bureau of Mines estimates that about 82 percent of the quantity of tungsten ore and concentrates (value not determined) credited to Peru by the U. S. Department of Commerce originated in Bolivia.

CONSUMPTION

Consumption of tungsten ore and concentrates in the United States was about 20,100 short tons (60 percent WO₃ basis) in 1944 compared with 20,300 tons in 1943. Of the total consumed in 1944, 11,800 tons or 59 percent were converted to ferrotungsten, the form in which most of the tungsten is introduced into steel. However, high-purity tungsten concentrates are charged directly to the steel bath; and 2,600 tons (13 percent of the total) were so used in 1944. Tungsten-metal powder and other tungsten products, chiefly the former, employed about 5,700 tons or 28 percent of the total ore and concentrates consumed in 1944. As shown in the following table, the production of tungsten-metal powder increased substantially in 1944 over 1943.

Production of specified tungsten products in the United States, 1943-44, in pounds

Product	1943		1944	
	Gross weight	Tungsten content	Gross weight	Tungsten content
Ferrotungsten.....	¹ 13,876,000	¹ 10,891,583	13,391,658	10,264,824
Tungsten-metal powder.....	2,741,099	2,739,036	4,123,867	4,117,586
Special tungsten alloys.....	(²)	(²)	317,684	196,277
Sodium tungstate ³	(²)	(²)	(²)	321,260
Tungstic oxide ⁴	(²)	(²)	492,966	390,233
Tungstic acid and ammonium paratungstate ⁵	(²)	(²)	625,911	452,968

¹ Excludes ferrotungsten produced under conversion agreement for a foreign consumer from consumer's own concentrates. ² Figures not available.

³ Figures cover production for sale only and therefore exclude production as an intermediate product by producers. Probably the greater part of the production reported for tungstic acid, tungstic oxide, and ammonium paratungstate is used in making tungsten powder.

WORLD PRODUCTION

Because of restrictions on the publication of statistics by many governments, a record of recent production in many countries is not available.

World production of tungsten ores, 1937-44, by countries, in metric tons of concentrates containing 60 percent WO₃¹

[Compiled by B. B. Waldbauer]

Country ¹	1937	1938	1939	1940	1941	1942	1943	1944
North America:								
Canada.....			4	6	32	244	788	466
Cuba (exports).....				(²)	(²)	7	7	
Mexico.....	33	76	229	216	191	193	516	336
United States (shipments).....	3,175	2,761	3,889	4,825	5,957	8,467	10,836	9,328
	3,208	2,837	4,122	5,047	6,180	8,911	12,157	10,130
South America:								
Argentina.....	866	1,195	1,309	1,417	1,720	2,115	2,420	2,488
Bolivia (exports).....	1,802	2,530	3,337	4,183	4,353	5,606	6,902	7,935
Brazil (exports).....	6	2	7	9	35	9	1,264	2,221
Chile.....	18	5	(²)	(²)	(²)	(²)	(²)	(²)
Peru.....	78	170	170	290	337	510	722	584
	2,770	3,902	(²)	(²)	(²)	(²)	(²)	(²)
Europe:								
France.....		22	(²)	109	95	76	100	62
Great Britain: Cornwall.....	148	258	188	201	127	198	237	(²)
Italy.....	3	4	2	(²)	(²)	(²)	(²)	(²)
Norway.....	3	19	31	(²)	(²)	(²)	(²)	(²)
Portugal.....	2,069	2,810	3,851	4,858	5,834	5,220	7,477	4,088
Spain.....	250	215	368	393	415	1,462	3,902	2,080
Sweden.....	127	180	200	(²)	(²)	(²)	(²)	(²)
	2,600	3,508	(²)	(²)	(²)	(²)	(²)	(²)
Asia:								
Burma.....	6,894	7,090	8,238	(²)	(²)	(²)	(²)	(²)
China (exports).....	17,895	13,387	11,580	3,118	(²)	8,624	12,040	8,987
Chosen.....	2,058	(²)	(²)	(²)	(²)	(²)	(²)	(²)
India, British.....	15	12	(²)	(²)	77	87	(²)	(²)
Indochina: Tonkin.....	648	545	510	392	(²)	4,130	(²)	(²)
Malay States:								
Federated.....	1,077	749	246	108	(²)	(²)	(²)	(²)
Unfederated.....	279	333	362	427	(²)	(²)	(²)	(²)
Netherlands Indies.....	(²)	(²)	2	(²)	(²)	(²)	(²)	(²)
Thailand.....	221	251	378	400	(²)	(²)	(²)	(²)
	29,087	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Africa:								
Belgian Congo.....				63	123	315	467	(²)
Egypt.....	193	(²)		15	43	17	42	16
Morocco, French.....		7	4	(²)	(²)	(²)	(²)	(²)
Nigeria.....	9	49	237	131	(²)	(²)	(²)	(²)
Southern Rhodesia.....	275	329	270	221	268	504	(²)	(²)
South-West Africa.....	41	48	50	24	116	115	188	119
Tanzanyika Territory (exports).....	2	5	(²)	2	1	2	3	
Uganda.....	2	2	2	(²)		7		(²)
Union of South Africa.....	40	127	100	105	142	400	430	4270
	562	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Oceania:								
Australia:								
New South Wales.....	66	124	117	76	95	52	75	(²)
Northern Territory.....	345	480	342	314	333	159	193	102
Queensland.....	110	193	93	129	137	217	176	(²)
Tasmania.....	345	400	477	607	577	475	463	300
New Zealand.....	28	54	49	88	79	73	121	154
	894	1,251	(²)	(²)	(²)	(²)	(²)	(²)
	39,121	438,000	440,000	(²)	(²)	(²)	(²)	(²)

¹ In addition to countries listed, tungsten ore is produced in Japan, U. S. S. R., and Western Australia, but data on production are not available. ² Data not available.

³ January to September, inclusive.

⁴ January to June, inclusive.

⁵ Less than 1 ton.

⁶ Estimate.

Argentina.—Argentina ranks second to Bolivia as a producer of tungsten in South America, but its place is being threatened by Brazil. Output in Argentina comes principally from San Luis and Córdoba Provinces; much smaller amounts are produced in San Juan, Catamarca, Mendoza, and La Rioja. Production was 2,262 and 2,200 metric tons (66 percent WO_3), respectively, in 1944 and 1943.

Bolivia.—Bolivia continues to be the largest tungsten producer in South America. Most of the deposits are in the Departments of La Paz, Oruro, Potosí, and Cochabamba. Output (as indicated by exports) was 7,935 and 6,902 metric tons (60 percent WO_3 basis), respectively, in 1944 and 1943.

Brazil.—Brazil became an important producer of tungsten in 1943 as a result of the discovery, early in 1942, of deposits of scheelite in the States of Paraíba and Rio Grande do Norte. Exports were 1,989 metric tons (67 percent WO_3) in 1944 and 1,167 tons (about 65 percent WO_3) in 1943. The scheelite deposits have been described by Johnston and De Vasconcellos.⁷ The following paragraphs are quoted from this article.

As all of the work to date consists of trenches and open cuts in surface material in which both residual and primary ore are mined, there are little data at hand about either the size or grade of the ore bodies. In several of the larger mines, ore zones have been traced along the strike of calcareous beds for a distance of 1 km. (0.6 mi.) or more. In these larger mines a pattern of ore shoots appears to be developing. Certainly, experience to date indicates that the ore bed varies greatly in its scheelite content as it is traced along the strike. The only quantitative data at hand are from Dr. Sandoval Carneiro de Almeida's exploration of the Monito mine. He found that in 20 trenches across the ore zone about 10 percent of the lineal distance was through material yielding more than 1.8 kilos (4.0 pounds) of scheelite per ton, 15 percent was through material yielding 1.1 to 1.8 kilos (2.4 to 4.0 pounds) per ton, and the remainder yielded less than 1.1 kilos (2.4 pounds) per ton. From ultra-violet lamp examinations of the hard ore of the larger mines, we formed the impression that most of the primary ore in the region contained less than 0.5 percent WO_3 , although some small pockets containing, perhaps, up to 1.5 percent WO_3 were seen. In some mines, however, there is a surface blanket enriched by residual concentration of scheelite. The grade of the concentrates ranges from 70 to 75 percent WO_3 , depending upon how well the material has been washed. In the final hand panning, losses are high.

All mining and milling is by hand methods. * * * Such hand methods are, of course, both wasteful and expensive and are possible with the low grade ores of the region only because of the low wage scale in relation to the present price of tungsten. Recently the Bodó mine has installed a small crushing plant for hard primary ore and table and jigs are on order.

At least 60 scheelite localities have been discovered in Paraíba and Rio Grande do Norte since early 1942, and new discoveries continue to be made. Present known localities are distributed throughout an area of about 15,000 square kilometers (9,300 square miles), and a similar geological environment extends over a large part of these two States whose combined area is more than 100,000 square kilometers (62,100 square miles). As the ultra-violet lamp was not introduced into the field until July 1943, most of these deposits were discovered without that aid. With the present production experience, more and more men in the area have learned to recognize scheelite and how to prospect for it. It is to be expected, therefore, that discoveries will continue to be made and it is very possible that better mines than those now known will be found.

China.—Production of tungsten declined to 3,235 metric tons in 1944 from 8,973 and 11,897 tons, respectively, in 1943 and 1942; the WO_3 content was not stated, but presumably it averaged about 70 percent. The reduced production in 1944 compared with 1943 was attributed primarily to the high cost of mining and to the loss of Hunan and Kwangsi Provinces to the enemy. Exports were 7,703

⁷ Johnston, W. D., Jr., and De Vasconcellos, F. M., Scheelite in Northeastern Brazil: Econ. Geol., vol. 40, No. 1, January-February 1945, pp. 34-60.

metric tons in 1944 compared with 10,320 and 7,392 tons, respectively, in 1943 and 1942.

Peru.—The first result of the Peruvian Government's effort to promote scientific exploitation of the country's mineral deposits is a 30-ton tungsten concentrator now operating near Callao.⁸ The flotation mill was designed in the ore-dressing laboratories of the newly founded Institute of Mining Engineering, maintained by the Government. Through this agency much encouragement has been given miners of strategic minerals in Peru, among them those working tungsten deposits in the Departments of Ancash and La Libertad and in the Provinces of Pallasca, Cabana, and Santiago de Chuco.

Production of tungsten in Peru was 584 metric tons (60 percent WO_3 basis) in 1944 compared with 722 tons in 1943 and with an average of 209 tons during the 5 years 1937–41.

Portugal.—As a result of greatly increased demand and competitive buying by the Allies and Germany, production of tungsten in Portugal advanced from 3,851 metric tons (60 percent WO_3 basis) in 1939 to 7,477 tons in 1943. However, on the eve of the invasion (June 6, 1944) of France by the Allies, Portugal prohibited the exportation of tungsten to Germany and, moreover, suspended the operation of existing mines and the development of new ones. Consequently, production of tungsten declined substantially; it was 4,088 tons during the first nine months of 1944.

Spain.—Production and disposition of tungsten in Spain have attracted much attention during World War II. Although a small tungsten producing country before the war, enormously increased demand and competitive buying by the Allies and Germany resulted in the opening of many new mines, most of which could not operate profitably except during wartime. As a consequence, reported production increased from 415 metric tons (60 percent WO_3 basis) in 1941 to 3,902 tons in 1943. Moreover, in Portugal quotations rose far above the price fixed in Spain, which led to extraordinary contraband activity. According to the Metal Bulletin:⁹

In the Spring of 1941 some 5,000 persons were illegitimately mining wolfram ore in the provinces of Cáceres and Salamanca adjacent to Portugal. There was also widespread contraband and wasteful exploitation in Galicia. Steps were taken to put an end to this by strict measures. * * * Between January and September 1942 the registered production rose from 50½ metric tons to 224½ tons monthly, making a nine months' total of 1,114 tons, whilst the probable illegal production fell from 202½ tons to 28½ tons a month making a total, however, of 1,163 tons of illegal output.

With the imposition of an embargo on petroleum by the Allies in February 1944, Spain suspended all exports of tungsten. In May 1944, exports to Germany were resumed on a limited basis, by agreement with the Allies, and the petroleum embargo was lifted. However, all exports of tungsten to Germany by land were stopped in August when the French border was closed to traffic. For these reasons, production of tungsten in Spain declined to 2,080 metric tons in 1944. At the close of 1944 only a few tungsten mines remained active as compared with 40 or 50 that were producing at the height of the tungsten boom.

⁸ Garcia, L. G., Government Tungsten Mill Aids Mining in Peru: Eng. and Min. Jour., vol. 145, No. 4, April 1944, p. 79.

⁹ Metal Bulletin (London), No. 2864, Jan. 28, 1944, p. 8.

BAUXITE AND ALUMINUM

By JOHN H. WEITZ AND MARY E. TROUGHT¹

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SUMMARY

Bauxite and aluminum production and consumption declined substantially during 1944 as the result of cut-backs, decreased requirements, and growing stocks. Domestic mine production of crude bauxite decreased 54 percent from the record output of the previous year, totaling 3,721,135 short tons (3,162,571 tons, dried equivalent) compared with 8,156,551 tons (6,980,829 tons, dried equivalent) in 1943. Cancellation and termination of contracts between Metals Reserve Company and many mine operators and voluntary production decreases by other operating companies caused a drop in the annual rate of output to only 1,450,000 tons by the end of 1944. Stocks at consumers' plants dropped from 1,706,113 tons to 835,530 during the year, and mine stocks declined slightly from 542,100 tons on January 1 to 528,700 tons on December 31. Imports of bauxite decreased 64 percent and totaled 627,716 tons, a smaller quantity than in any year since 1939; a comparable drop was registered in exports, which fell 65 percent and totaled 164,234 tons in 1944.

Actual domestic consumption of bauxite in 1944 was 3,874,933 short tons (dried equivalent), a 27-percent decrease from the 5,332,151 tons consumed in 1943. Of all the domestic and foreign ore consumed, the alumina industry used 87.7 percent; chemical, 3.9 percent; abrasive and refractory, 7.5 percent; and other industries, 0.9 percent. Consumption of bauxite in the alumina industry in 1944 decreased 29 percent compared with 1943, and decreases in other industries were as follows: Chemical, 16 percent; abrasive and refractory, 17 percent; and cement, ferro-alloy, and oil refining, 13 percent. Of the bauxite consumed, 22 percent was imported, and 78 percent was domestic; 94 percent of the imported ore was used by the alumina industry.

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Primary aluminum production in 1944 dropped 15.6 percent and totaled 776,446 short tons compared with the peak of 920,179 tons reached in 1943. The annual rate of output decreased from 1,017,000 tons in January to 560,000 in December 1944 owing to curtailed operations at many of the aluminum reduction plants. Military reverses in Europe in December caused a revision of requirements, and a shortage of aluminum during 1945 was threatened. Accordingly, production of the metal was increased early in 1945. The average value of the primary aluminum shipped in 1944 was 14.32 cents a pound compared with 14.42 cents in 1943. Imports of crude and semicrude aluminum decreased 24 percent and totaled 102,753 tons in 1944; exports, on the other hand, increased 60 percent to a record high mark of 188,521 tons. Recovery of secondary aluminum totaled 325,645 tons in 1944. Apparent consumption of primary aluminum in 1944 decreased 15 percent and totaled 745,998 short tons compared with 877,381 tons in 1943.

World production of bauxite and aluminum in 1944 decreased 48 and 12 percent, respectively. The United Nations output was estimated at 72 percent of the world total for bauxite and 71 percent of the total for aluminum.

Salient statistics of the bauxite and aluminum industries in the United States, 1942-44

	1942	1943	1944
Bauxite:			
Production (crude ore) ¹ short tons..	2,914,278	6,980,829	3,162,571
Value ²	\$12,981,400	\$30,654,900	\$14,402,497
Imports ³ short tons..	990,323	1,733,596	627,716
Exports (including concentrates) ³ do....	291,872	467,248	164,234
World production ⁴ do....	8,812,500	14,602,600	7,664,400
Aluminum:			
Primary production.....do....	521,106	920,179	776,446
Value.....	\$151,371,000	\$265,380,000	\$222,416,000
Quoted price per pound ⁴ cents..	15.0	15.0	15.0
Secondary production.....short tons..	196,404	313,961	325,645
Imports.....	\$37,147,891	\$41,817,044	\$30,322,653
Exports.....	\$26,948,686	\$67,198,796	\$90,320,441
World production ⁴ short tons..	1,529,600	2,176,400	1,922,100

¹ Dried bauxite equivalent of mine production.

² As shipped.

³ Estimated.

⁴ Ceiling price.

BAUXITE PRODUCTION

Domestic mine production of crude ore in 1944 dropped sharply to 3,721,135 short tons (3,162,571 tons, dried equivalent), a decline of 54 percent from the record total of 8,156,551 tons (6,980,829 tons, dried equivalent) produced in 1943. The outstanding reason for this decrease was the cancellation and termination of many of the bauxite-mining contracts between Metals Reserve Company and numerous operators. The Company cancellation-termination policy was the result of three factors: (1) A substantial drop in domestic consumption resulting from cut-backs in alumina and aluminum production ordered by the War Production Board; (2) the accumulation of excessively large stock piles, held by both Government and private industry; and (3) the assurance that the Canadian aluminum industry would be able to import its requirements from South America and not have to draw on United States stocks. The annual rate of

output had declined to about 1,450,000 short tons, dried equivalent, by December 1944.

Production of bauxite dropped 55 percent in Arkansas, 33 percent in Alabama, and 23 percent in Georgia. No output was reported from Virginia during 1944. In Saline and Pulaski Counties, Ark., whence 96 percent of the 1944 production came, 22 companies were operating mines at the beginning of the year and only 6 at the end.

Production and shipments of crude bauxite from mines in the United States, 1940-44, by States, in short tons

State and year	Production			Shipments to processing plants, consumers, and Government stock piles		
	Crude	Dried bauxite equivalent	Value	Crude	Dried bauxite equivalent	Value f. o. b. mine
Alabama, Georgia, and Virginia:						
1940.....	13, 761	12, 024	\$56, 800	14, 896	13, 095	\$59, 296
1941.....	104, 800	90, 556	351, 200	102, 819	89, 070	345, 118
1942 ¹	186, 910	159, 183	808, 900	185, 354	159, 027	801, 060
1943.....	257, 160	219, 960	1, 227, 600	251, 294	215, 788	1, 193, 759
1944.....	167, 366	143, 816	723, 470	172, 479	148, 246	751, 557
Arkansas:						
1940.....	557, 296	479, 888	1, 697, 200	552, 988	477, 160	1, 685, 433
1941.....	1, 110, 459	958, 940	4, 324, 300	1, 058, 755	915, 900	4, 124, 134
1942.....	3, 194, 297	2, 755, 095	12, 172, 500	3, 038, 260	2, 618, 318	11, 576, 098
1943.....	7, 894, 391	6, 760, 809	29, 432, 300	7, 645, 023	6, 516, 730	28, 487, 923
1944.....	3, 553, 769	3, 018, 755	13, 679, 027	3, 504, 019	2, 976, 359	13, 465, 057
Total United States:						
1940.....	571, 057	491, 912	1, 754, 000	567, 884	490, 255	1, 744, 729
1941.....	1, 215, 259	1, 049, 496	4, 675, 500	1, 161, 574	1, 004, 970	4, 469, 252
1942.....	3, 381, 207	2, 914, 278	12, 981, 400	3, 223, 614	2, 777, 345	12, 377, 758
1943.....	8, 156, 551	6, 980, 829	30, 659, 900	7, 896, 317	6, 732, 518	29, 681, 682
1944.....	3, 721, 135	3, 162, 571	14, 402, 497	3, 676, 498	3, 124, 605	14, 216, 614

¹ Includes Mississippi.

Recovery of processed bauxite in the United States, 1940-44, in short tons

Year	Crude ore treated	Processed bauxite recovered			
		Dried	Activated, calcined, or sintered	Total	Dried bauxite equivalent
1940.....	505, 172	305, 234	27, 199	332, 433	355, 968
1941.....	1, 033, 414	631, 575	162, 971	794, 546	890, 303
1942.....	1, 942, 933	1, 358, 520	185, 985	1, 544, 505	1, 633, 379
1943.....	2, 852, 471	2, 132, 848	385, 490	2, 518, 338	2, 690, 690
1944.....	1, 577, 346	1, 080, 367	170, 761	1, 251, 128	1, 331, 533

Alabama.—Six mining companies produced bauxite in Alabama during 1944, and a seventh company purchased ore for consumption at its drying plant. Barbour Bauxite Co., Bauxite Co. of Alabama, Floridin Co., General Ore Co., Republic Mining & Manufacturing Co., and D. M. Wilson Bauxite Co. were active in the Eufaula district in Barbour and Henry Counties during the year. The ore was sold in crude, dried, and activated form to the alumina, refractory, chemical, and oil-refining industries. Drying plants were operated by Bauxite Co. of Alabama, Chas. Lennig & Co., Inc., and Republic Mining & Manufacturing Co. The Lennig mine and drying plant were sold to the D. M. Wilson Bauxite Co. during the year, and Chas.

Lennig & Co., Inc., reports that it does not plan any further bauxite operations in Alabama.

Arkansas.—American Cyanamid & Chemical Corp. operated the Heckler, Rauch Leased, Rauch Owned, England, and Berger No. 100 mines in Pulaski County, Ark., and the Globe No. 28, Quapaw, Ozark No. 28, and Townsend mines in Saline County. The leases on the McDonald, Ozark 24, Fletcher, Cargill, and Consolidated (Gates lease) mines were allowed to expire during 1944, and the properties reverted to control of the owners. The company continued to operate its gas-fired drying plant at Berger, Pulaski County, and a similar plant at West Bauxite, Saline County. The calcining plant at West Bauxite was not operated during the year, but the company sintering plant at the same location was active throughout 1944 and supplied sintered bauxite to the abrasive industry. Consolidated Chemical Industries, Inc., shipped chemical-grade bauxite from a stock pile at the Bierman mine in Pulaski County and from a stock pile at the Alexander No. 2 mine in Saline County on which it formerly held a lease. Crouch Mining Co., Inc. (owned by General Abrasives Co.), continued to calcine abrasive-grade ore produced from its Young mine near Bauxite, Saline County. Until the property was leased late in 1944, Dixie Bauxite Co. produced bauxite from its Dixie No. 2 mine near Sweet Home, Pulaski County, for the aluminum industry. On November 21 the mine was leased to the Dulin Bauxite Co., but Dixie continued to ship aluminum-grade ore from accumulated stocks.

Dulin Bauxite Co., Inc., mined bauxite in Pulaski County for sale to the Metals Reserve Company from the Thorpe, Ratcliffe, and Brown properties and for calcining at its own plant from the Thorpe, Harley, Dixie, Ratcliffe, Penzel and Coe, and Brown mines. Leases on the Thorpe and Harley mines were surrendered to the owners during 1944. The Ratcliffe mine was operated only from September to December, and the Penzel and Coe mine, which comprises two ore bodies mined from the same shaft, was closed because of a lack of labor from October 15 to the end of the year. The calcining plant of the company at Sweet Home operated throughout the year to supply calcined bauxite to the abrasive trade. The mine and calcining plant of the Norton Co. near Bauxite, Saline County, supplied bauxite solely for the abrasive trade during 1944. Porocel Corp. continued to operate its activating plant and its plant for the impregnation of activated bauxite with anhydrous aluminum chloride at Berger, Pulaski County; the company does not operate a mine but purchases all requirements of dried bauxite from local producers.

The Ratcliffe open-pit mine of Republic Mining & Manufacturing Co. near Sweet Home, Pulaski County, produced high-grade bauxite for sale to the nearby Drury calcining plant of its affiliate, Aluminum Ore Co., which calcined the ore for sale to the abrasive industry. In Saline County the company dried and calcined bauxite at its facilities near Bauxite for sale to alumina and abrasive plants. Underground mines operated by Republic Mining & Manufacturing Co. in Saline County included the Neilson, Section 26, Bertha, and Young; open-pit mines included the Elrod, Lantz, Section 10, Canal No. 1, Section 14, African Camp, Alexander Hill, Section 15, Lone 7th, Pruden, Pruden Extension, Poodle, Section 17, Spring Hill, Section 16, Davis (includes some underground workings), Bertha Extension

sion, South Maud, East Maud, and Middle Maud. Reynolds Mining Corp. operated the Sherrill and Hoekstra open-cut mines in Pulaski County. In Saline County the company operated the Hurricane Nos. 1 and 3, and Covington Nos. 4 and 5 underground mines, and the Stuckey open-cut mine. The Ulmer mine in Saline County was idle throughout the year, and its ore reserves are said to be exhausted.

All of the afore-mentioned companies produced ore for sale directly to the alumina, abrasive, chemical, and other industries; in addition, several sold bauxite on contract to the Metals Reserve Company for stock-piling purposes and for use in the Government-owned Hurricane Creek alumina plant. The remainder of the companies operating in Arkansas produced bauxite solely for sale on contract to Metals Reserve Company. Aluminite Mining Corp. produced ore from the Winn open-pit mine in Pulaski County from June through November when the property was closed. The McGuire and Willie Thomas open-cut mines in Pulaski County and the Ramsey open pit in Saline County were operated during January and February by the Arkansas Bauxite Stripping Co. No production is expected during 1945. Fourche Mountain Mining Co. mined bauxite from the Rauch North 20 open pit in Pulaski County in January only and probably will not operate in 1945. Hull-Macke Bauxite Mining Co. operated an underground mine on the Childress property in Saline County throughout the year. The name of the company was changed to Macke Mining Co. on June 21, 1944. Hurricane Creek Mining Co. mined from the Ozark No. 24 open pit in Saline County under a sublease from American Cyanamid & Chemical Corp. The sublease was surrendered and the corporation contract with Metals Reserve Company canceled on October 10, 1944.

The open pit on the Hoekstra-Dobbs-Illing tract in Pulaski County was operated throughout 1944 by Jackson & Squire. Kenark Mining Co. mined from an open pit on the Westminster Church-Thomas-Barner-Porter property in Pulaski County during January, and its contract with Metals Reserve Company was canceled June 5, 1944. No further operations are planned by this company. E. G. Schoffner, receiver, mined from the Sam. J. Lewis lease on the W. C. Dollar property in Pulaski County until February 1944, when the receivership was transferred to Verne McMillen. The latter operated the open-cut mine until November 15, when the Metals Reserve Company contract was canceled; no production is expected in 1945. The Gray open-cut mine in Saline County was operated by Midwest Mines Co. from January to September 1944, at which time production ceased, and the mine was reported to be exhausted. Osage Bauxite Co. mined ore from its Bryant underground mine in Saline County from January through October. The Burke-Nelson mine and the Ratcliffe Pit, both open-cut operations of the Pulaski Mining Co. in Pulaski County, were in production from January through November, but it is reported that reserves on both properties are exhausted. The underground Martin mine of Schafer & Haire Bauxite Co. near Bryant, Saline County, operated throughout 1944. Sweet Home Bauxite Co. produced ore in February only and reported that its open-cut Sweet Home mine in Pulaski County was exhausted and abandoned. Metals Reserve Company canceled its contract with Taff, Fleming, Dryden, & McWorkman on November 15, 1944; its underground Rowland mine reverted to R. M. T aylor, owner of this

Saline County property. The lease on the Wright underground mine in Pulaski County held by Wells Mining Co. was relinquished in June after suspension of mining, and no further operations are expected. The following companies which had mined bauxite in 1943 did not operate during 1944, and further operations are unlikely: Billy Bridewell and Maner Graham (Hogue-Fletcher, open pit), Clarke Bauxite Co. (Dixie lease, open pit), S. E. Evans Construction Co. (Bizzell, open pit), Leydig & Fleming (Fletcher-Hudspeth-Harris, open pit), Porter Dewitt Construction Co. (Missouri-Pacific lease), Roy Prewitt (Keenzel and Morgan open pits), and Victory Bauxite Co. (Weiss, open pit). Inasmuch as 1945 mine production is expected to be well below the 1944 total, it is very unlikely that any new operators will enter the field.

Georgia.—In Georgia both American Cyanamid & Chemical Corp. and Republic Mining & Manufacturing Co. operated mines and drying plants during 1944. Cyanamid produced bauxite from the Thig Pen mine in the Andersonville district, Sumter County, and Republic worked its mines in the Hermitage area of Floyd County. All ore was shipped to the alumina and chemical industries in dried form. No other producers were active in Georgia in 1944.

Virginia.—Some crude bauxite was shipped from stock to the refractory trade from Republic Mining & Manufacturing Co. mines near Spottswood, Augusta County, Va., but no mine production was reported during the year.

Work of Geological Survey and Bureau of Mines.—During 1944 the Geological Survey continued its work in the Arkansas bauxite area examining deposits, locating and logging drill holes, and furnishing information for war mineral reports on bauxite prepared by the Bureau of Mines. A final report on the Survey's work on bauxite is in preparation, and detailed maps showing the results of drilling are being prepared for both the Saline and Pulaski County districts. A small amount of geologic work was also done in Alabama during the year.

The Bureau of Mines continued its drilling operations in both Saline and Pulaski Counties, Ark., although the program was curtailed somewhat in 1944. In the latter part of 1943, 20 drill rigs were operating, but by the end of 1944 the number was reduced to 12. In general the objective of the drilling program during the year was to define limits of the areas favorable for the occurrence of bauxite, to explore for bauxite within those areas, and to investigate by drilling the deposits thus discovered. From the beginning of the drilling program to the end of 1944, 38 bauxite and 8 clay deposits have been discovered and either completely or partly delimited. The total number of holes drilled and accepted for payment during 1944 was 2,412, representing a total footage of 632,542. Over 16,000,000 long wet tons of merchantable bauxite in place were delimited during the year, in addition to about 26,500,000 tons of submarginal bauxite and bauxitic clay. The average tonnage of merchantable bauxite discovered per drill hole was 6,706, or 25.6 tons per foot drilled, and the average total tonnage of bauxite and bauxitic clay discovered per hole was 17,671 and per foot drilled was 67.4. From December 1941

to December 31, 1944, the total merchantable ore discovered was about 23,500,000 tons, and the total submarginal bauxite and bauxitic clay was over 34,000,000 tons. For the entire 3-year period the average discovery cost per ton of merchantable bauxite was \$0.0810, and per ton of bauxite and bauxitic clay \$0.0328 including geophysical exploration, drilling, and laboratory costs.

Bureau of Mines laboratory work on the beneficiation of low-grade bauxites to produce a Bayer-grade product continued at Rolla, Mo., and a 50-ton-a-day pilot plant for beneficiating bauxite was constructed during 1944 at Hurricane Creek, Ark., by the Bureau of Mines. Laboratory and pilot plant work on the lime-soda-sinter and various acid processes for producing alumina from clay was continued during the year by the Bureau of Mines.

Stocks.—Stocks of bauxite on hand at mines and processing plants on December 31, 1944, totaled 528,700 short tons (dried equivalent) compared with 542,100 (revised figure) on December 31, 1943. Stocks at consumers' plants decreased from 1,706,113 tons at the beginning of the year to 835,530 at the end.

CONSUMPTION

Actual domestic consumption of bauxite (as determined by special monthly consumer surveys conducted by the Bureau of Mines totaled 3,874,933 short tons (dried equivalent) in 1944 compared with 5,332,151 tons in 1943, a decline of 27 percent. The consumption figures for both years include calcined bauxite shipped for export to American-owned abrasive plants in Canada for the manufacture of crude abrasives which are returned to the United States for final manufacture and consumption. Of the 3,874,933 tons of bauxite consumed in 1944, the alumina industry used 87.7 percent or 3,397,971 tons, chemical industry 3.9 percent or 150,274 tons, abrasive and refractory industries 7.5 percent or 292,052 tons, and the cement, oil-refining, and steel and ferro-alloy industries 0.9 percent or 34,636 tons. Consumption of bauxite "as shipped" totaled 3,977,474 tons and consisted of 1,661,649 tons of crude bauxite, 2,124,276 tons of dried ore, 177,013 tons of calcined and sintered ore, and 14,536 tons of activated ore. Of the bauxite consumed (dried equivalent basis), 22 percent was foreign and 78 percent domestic. Of the foreign ore consumed the alumina industry used 94 percent and chemical, abrasive, cement, and other industries took the remaining 6 percent.

Domestic consumption, shown in the following table, is presented upon two different bases. Apparent consumption within the United States does not correspond with the data above, inasmuch as calculations are based upon shipments to domestic plants and do not consider fluctuations in consumers' stocks (including Government stock piles). Actual consumption, including shipments to Canada for processing, is based upon monthly consumer surveys and eliminates shipments destined for stock piles.

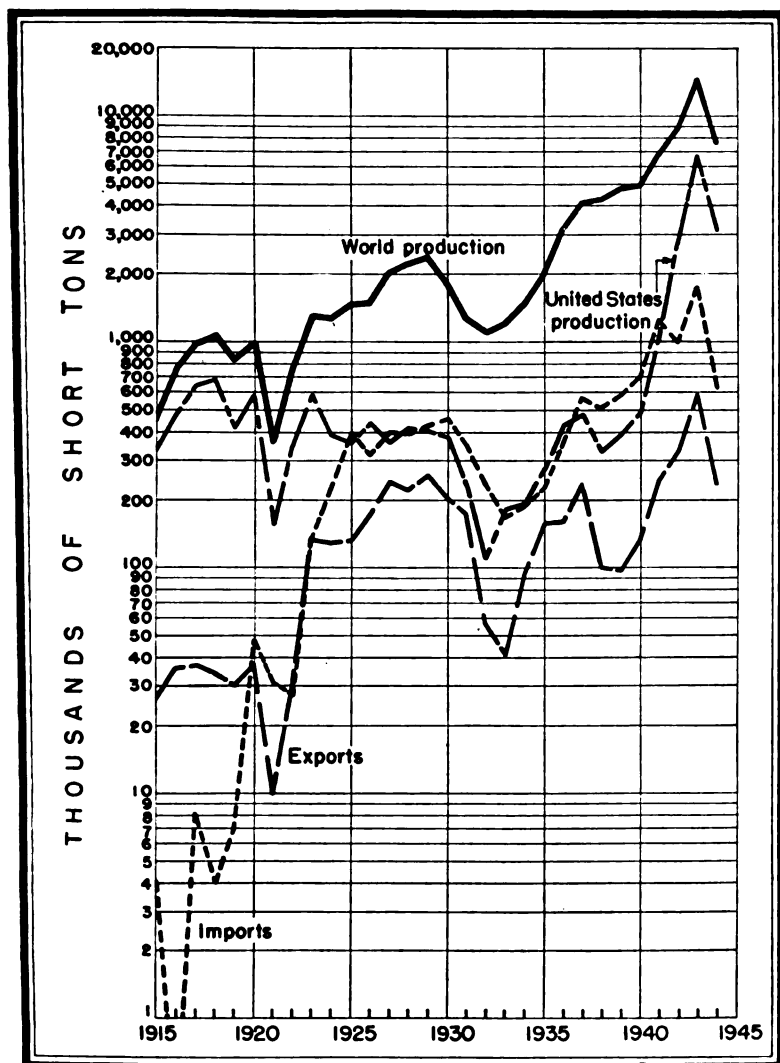


FIGURE 1.—Trends in domestic production, imports, exports, and world production of bauxite, 1915-44

Shipments, imports, exports, and apparent consumption of bauxite in the United States, 1940-44, in short tons

[Dried-bauxite equivalent]

Year	Domestic shipments from mines and processing plants to industry			Imports	Exports	Apparent consumption within United States	Apparent consumption, including shipments to Canada for processing ¹
	Arkansas	Alabama, Georgia, and Virginia ²	Total				
1940.....	490, 107	12, 995	503, 102	705, 098	134, 462	1, 073, 738	1, 200, 600
1941.....	960, 741	89, 389	1, 050, 130	1, 250, 532	244, 934	2, 055, 728	1, 928, 052
1942.....	2, 588, 637	153, 663	2, 742, 300	990, 323	329, 477	3, 403, 146	2, 820, 525
1943.....	6, 457, 351	204, 232	6, 661, 583	1, 726, 961	592, 300	7, 796, 244	5, 332, 151
1944.....	2, 877, 023	146, 116	3, 022, 139	622, 325	236, 154	3, 408, 310	3, 874, 933

¹ Includes exports to Canada, inasmuch as virtually all of this bauxite is shipped to American-owned plants in Canada for manufacture into crude abrasives reimported into the United States for final manufacture and consumption.

² Includes Mississippi in 1942.

³ Actual consumption.

BY INDUSTRIES

The following table shows only shipments of domestic bauxite to consuming industries and excludes foreign ore.

Bauxite shipped from mines and processing plants in the United States, 1941-44, by consuming industries, in short tons

Industry	1941		1942		1943		1944	
	As shipped ¹	Dried bauxite equivalent	As shipped ¹	Dried bauxite equivalent	As shipped ¹	Dried bauxite equivalent	As shipped ¹	Dried bauxite equivalent
Alumina.....	618, 763	597, 607	2, 445, 365	2, 266, 839	6, 804, 708	6, 052, 659	2, 943, 900	2, 615, 354
Chemical.....	161, 037	158, 294	183, 804	174, 826	273, 780	270, 873	143, 923	142, 829
Abrasive ²	148, 562	237, 980	170, 060	251, 497	199, 742	289, 387	160, 596	234, 231
Oil refining, refractory, ³ and other..	51, 370	56, 249	47, 366	49, 138	43, 570	48, 664	22, 600	29, 725
Total quantity.....	979, 732	1, 050, 130	2, 846, 595	2, 742, 300	7, 321, 800	6, 661, 583	3, 271, 019	3, 022, 139
Total value.....	\$6, 165, 714		\$13, 072, 727		\$33, 372, 382		\$15, 814, 431	

¹ Includes crude, dried, calcined, activated, and sintered.

² Includes 672,000 tons (584,640 dried equivalent) shipped to Metals Reserve Company stock piles.

³ Includes 3,791,059 tons (3,195,106 dried equivalent) shipped to Metals Reserve Company stock piles.

⁴ Includes 1,785,826 tons (1,492,594 dried equivalent) shipped to Metals Reserve Company stockpiles.

⁵ Small quantity of bauxite shipped to makers of refractories probably included under "Abrasive."

Alumina.—Bauxite consumption by the alumina industry in 1944 decreased approximately 29 percent from that in the previous year, totaling 3,397,971 tons compared with 4,761,049 tons in 1943. Of all the bauxite consumed in 1944, the alumina industry used 87.7 percent compared with 89.0 percent the preceding year. Domestic bauxite consumed totaled 2,574,681 tons or 76 percent, whereas foreign ore consumed totaled 823,290 tons or 24 percent. The industry employed crude and dried ore from Alabama, Arkansas, Georgia, Surinam, and British Guiana. Not all bauxite consumed in the manufacture of alumina is destined to emerge finally as aluminum metal, since some of the alumina is used by the chemical, abrasive, and refractory industries, and some of it is processed into special products such as activated and tabular aluminas for use in the oil-refining and ceramic

industries. Consumption of bauxite in the alumina industry is expected to decrease further in 1945.

Chemical.—The chemical industry used 3.9 percent of all domestic and foreign bauxite consumed in 1944, but consumption in the industry dropped 16 percent, exclusive of ore used to produce alumina for chemical purposes. Shipments of domestic bauxite from mines and processing plants to the chemical industry decreased 47 percent from 1943. Consumption by the industry totaled 150,274 short tons, but this included ore used to make some aluminum chemicals other than those shown in the following table and did not include a large portion of the bauxite used in the manufacture of the alumina shown in the table. Ore used to manufacture the aluminum salts and alumina shown in the table totaled approximately 309,979 tons, of which 292,935 tons (94.5 percent) was domestic, and 17,044 tons (5.5 percent) was foreign bauxite. In addition to bauxite, producers of aluminum salts reported consuming 11,279 tons of commercial aluminum trihydrate, 9,784 tons of secondary aluminum, scrap, and dross, 113,575 tons of clay, 274 tons of alunite, and a quantity of bichromate residue.

Production and shipments of aluminum salts increased 3 percent in quantity and value in 1944. Production of alumina (aside from that used in making aluminum) decreased 10 percent, and shipments decreased 11 percent. Of this alumina, only 9 percent was consumed by aluminum salts producers; the remainder was used by manufacturers of abrasives, refractories, petroleum products, spark plugs, glass, rubber, paints, and various other commodities.

Aluminum salts and alumina produced and shipped in the United States, 1943-44

	1943				1944			
	Production Short tons	Shipments			Production Short tons	Shipments		
		Ship- pers	Short tons	Value		Ship- pers	Short tons	Value
Aluminum salts:								
Alum:								
Ammonia.....	11,041	6	11,292	\$735,203	7,969	6	7,744	\$515,637
Potash.....	1 3,774	5	1 4,121	1 311,153	4,530	5	4,049	303,404
Aluminum chloride:								
Liquid.....	2,953	5	3,025	127,570	5,468	4	5,513	240,356
Crystal.....	20,744	8	21,069	1 3,652,450	24,443	8	24,163	3,863,946
Anhydrous.....								
Aluminum sulfate:								
Commercial:								
General.....	545,934	10	542,930	12,400,236	566,322	10	555,047	12,751,763
Municipal.....	12,574	9	12,750	224,680	12,145	7	12,142	242,311
Iron-free.....	15,821	5	16,339	665,309	24,193	5	23,476	877,597
Sodium aluminum sulfate.....	23,977	2	30,801	2,116,769	23,810	2	28,154	1,946,512
Sodium aluminate.....		12				13		
Total aluminum salts.....	1 641,818	-----	1 642,327	120,233,370	673,910	-----	660,288	20,742,025
Alumina ²	86,420	12	87,584	7,457,253	77,971	10	78,168	7,084,979

¹ Revised figure. Salts made from iron-free aluminum sulfate omitted.

² Excludes alumina produced for use in making aluminum; includes activated, calcined, crude, light and heavy hydrate, converted to a calcined alumina equivalent.

Aluminum salts shipped in, imported into, and exported from the United States, 1940-44

Year	Domestic shipments		Imports		Exports			
					Aluminum sulfate		Other aluminum compounds	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	513, 520	\$12, 882, 578	21	\$866	43, 615	\$994, 861	1, 920	\$271, 715
1941.....	626, 384	17, 382, 675	(¹)	231	51, 261	1, 184, 169	2, 815	349, 951
1942.....	² 604, 487	² 17, 723, 343	(¹)	4	44, 428	1, 103, 340	2, 384	354, 397
1943.....	² 642, 327	² 20, 233, 370	3	941	37, 946	963, 151	2, 922	307, 288
1944.....	660, 288	20, 742, 026	-----	-----	41, 434	1, 072, 140	3, 802	528, 821

¹ 147 pounds in 1941 and 50 pounds in 1942.² Revised figure. Salts made from iron-free aluminum sulfate omitted.

Abrasive and refractory.—Manufacturers of crude aluminous abrasive pigs in Canada and the United States and manufacturers of bauxite refractories in the United States used 292,052 tons (7.5 percent) of all the foreign and domestic bauxite consumed in 1944, a 17-percent decrease from the 352,423 tons used in 1943. Except for a relatively small quantity from British Guiana, all the ore requirements of the industry were supplied from Saline and Pulaski Counties, Ark.

Other.—Consumption of bauxite in the cement, steel, ferro-alloy, and oil-refining industries decreased 13 percent in 1944. However, the use of thermally activated bauxite as a drying adsorbent² and as a catalyst and catalyst carrier³ has become increasingly important during the past year.

*Principal bauxite consumers in the United States during 1944***Abrasive and refractory industries:**

Abrasive Co., Philadelphia, Pa.
 Babcock & Wilcox, Old Savannah Road, Augusta, Ga.
 The Carborundum Co., Niagara Falls, N. Y.
 Corhart Refractories Co., Sixteenth and Lee Streets, Louisville 10, Ky.
 The Exolon Co., Tonawanda, N. Y.
 General Abrasive Co., Inc., Niagara Falls, N. Y.
 Monsanto Chemical Co., 1700 South Second Street, St. Louis, Mo.
 Norton Co., 50 New Bond Street, Worcester 6, Mass.

Alumina industry:

Aluminum Ore Co., Gulf Building, Pittsburgh 19, Pa.
 Reynolds Metals Co., Reynolds Metals Building, Richmond, Va.

Chemical industry:

Activated Alum Corp., Baltimore 1, Md.
 Aluminum Ore Co., Gulf Building, Pittsburgh 19, Pa.
 American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York 20, N. Y.
 Brown Co., Berlin, N. H.
 Consolidated Chemical Industries, Inc., 640 Mellie Esperson Building, Houston 2, Tex.
 Davison Chemical Corp., 20 Hopkins Place, Baltimore 3, Md.
 E. I. duPont de Nemours & Co., 1007 Market Street, Wilmington 98, Del.
 Gaylord Container Corp., Bogalusa, La.
 General Chemical Co., 40 Rector Street, New York 6, N. Y.

² La Lande, W. A., Jr., McCarter, W. S. W., and Sanborn, J. B., Bauxite as a Drying Adsorbent: *Ind. Eng. Chem.*, vol. 36, No. 2, February 1944, pp. 99-109.³ King, H. L., Jr., Laughlin, C. D., and Gwyn, H. M., Jr., Bauxite as an Adsorbent, Catalyst, and Catalyst Carrier: *Oil and Gas Jour.*, vol. 42, No. 49, sec. 1, Apr. 13, 1944, pp. 236-244 (part I); and vol. 42, No. 50, Apr. 20, 1944, pp. 71-74 (part II).

Chemical industry—Continued.

Gulf Oil Corp., Post Office Box 1166, Pittsburgh 30, Pa.
 Hercules Powder Co., 908 Market Street, Wilmington, Del.
 Hilton-Davis Chemical Co., Post Office Box 8, Pleasant Ridge Station, Cincinnati 12, Ohio.
 Charles Lennig & Co., Inc., 222 West Washington Square, Philadelphia 5, Pa.
 Monsanto Chemical Co., 1700 South 2d St., St. Louis, Mo.
 Pennsylvania Salt Mfg. Co., Widener Building, 1335 Chestnut Street, Philadelphia 7, Pa.
 Stauffer Chemical Co., 624 California Street, San Francisco 8, Calif.
 Westvaco Chlorine Products, Carteret, N. J.

Municipal water works:

Birmingham Water Works Co., 50 Broad Street, New York 4, N. Y.
 Board of Public Utilities, Kansas City Water Department, Kansas City 16, Kans.
 Bureau of Water Supply, Baltimore 12, Md.
 City of Columbus Purification Works, Columbus 8, Ohio.
 Kansas City Water Department, Kansas City 6, Mo.
 Metropolitan Utilities District, Water Department, Eighteenth and Harney Streets, Omaha 2, Nebr.
 Passaic Valley Water Commission, Box 268, Little Falls, N. J.
 City of Sacramento, Filtration Division, Sacramento 16, Calif.
 United States Engineer Office, Dalecarlia Filter Plant, Washington, D. C.

Other industries:

Atlas Lumnite Cement Co., Chrysler Building, New York 17, N. Y.
 Crucible Steel Co. of America, 405 Lexington Avenue, New York 17, N. Y.
 Electro Metallurgical Company, 30 E. Forty-second Street, New York 17, N. Y.
 Vanadium Corporation of America, 420 Lexington Avenue, New York 17, N. Y.

This list does not include many oil-refining companies which are small users of activated bauxite.

PRICES

In 1944 the average selling price, f. o. b. mines and processing plants, was \$3.87 per short ton for crude (undried) bauxite, \$4.99 for crushed dried bauxite, \$12.65 for calcined bauxite, and \$50.60 for activated bauxite. Values per long ton were as follows: \$4.33 for crude, \$5.59 for dried, \$14.17 for calcined, and \$56.67 for activated. The average value for all grades of domestic ores as shipped was \$4.85 a short ton (\$4.56 in 1943) or \$5.43 a long ton (\$5.11 in 1943). Nominal market quotations, given in the following table from E&MJ Metal and Mineral Markets, remained static in 1944 for all grades of domestic bauxite.

The Metals Reserve Company purchased bauxite in Arkansas throughout 1944 for delivery to the stock-pile depots at Sweet Home, Ward Spur, and Hurricane Creek. The special price schedule (next page) set up by Metals Reserve Company is based on percentages of contained alumina, silica, and ferrous iron. The base price is \$4.15 a long ton for ore containing 50 percent Al_2O_3 , 13 percent SiO_2 , and less than 6 percent FeO . Bonuses are as follows: 20 cents a ton for each percent of silica under 13, and 14 cents a ton for each percent of alumina over 50. Penalties are as follows: 43 cents a ton for each percent of silica over 13; 14 cents for each percent of alumina under 50; and 43 cents for each percent of iron in the ferrous state calculated as FeO . This price schedule has been in effect since September 1943.

FOREIGN TRADE

Imports of bauxite in 1944 decreased 64 percent from 1943, dropping to 627,716 short tons, the lowest since 1939. Exports decreased 65

Range of quotations on bauxite, 1941-44

Type of ore	Chemical specifications (percent)		Prices during year			
	Al ₂ O ₃	SiO ₂	1941	1942	1943	1944
Domestic ore (per long ton):						
Crude ¹	50-52	(?)	\$4.00	\$5.00	\$5.00	\$5.00
Chemical, crushed and dried ²	55-58	(?)	\$7.00- 8.50	\$7.50- 8.50	\$7.50- 8.50	\$7.50- 8.50
Other grades ¹	56-59	5-8	7.00- 8.50	7.50- 8.50	7.50- 8.50	7.50- 8.50
Pulverized and dried ¹	56-59	8-12	14.00- 16.00	14.00- 16.00	14.00- 16.00	14.00- 16.00
Abrasive grade, crushed and calcined ¹	78-84	(?)	14.00- 16.00	16.00	16.00	16.00
Domestic ore (per short ton): ³						
Crude ¹	50-52	(?)	3.57	4.46	4.46	4.46
Chemical, crushed and dried ²	55-58	(?)	6.25- 7.59	6.70- 7.59	6.70- 7.59	6.70- 7.59
Other grades ¹	56-59	6- 8	6.25- 7.59	6.70- 7.59	6.70- 7.59	6.70- 7.59
Pulverized and dried ¹	56-59	8-12	12.50- 14.29	12.50- 14.29	12.50- 14.29	12.50- 14.29
Abrasive grade, crushed and calcined ¹	78-84	(?)	12.50- 14.29	14.29	14.29	14.29
Foreign ore (per metric ton):						
Dalmatian ⁴	80-85	1- 3	7.00- 8.00	(?)	(?)	(?)
Greek ⁵	80-88	2- 5	7.00- 8.00	(?)	(?)	(?)
French ⁶	56-59	2- 4	7.00- 8.00	(?)	(?)	(?)

¹ F. o. b. Arkansas mines.² Not specified.³ F. o. b. Alabama and Arkansas mines.⁴ SiO₂ not specified; Fe₂O₃, 1.5-2.5 percent.⁵ Calculated.⁶ C. I. f. Atlantic ports.⁷ Not published after February 6, 1941.

Metals Reserve Company bauxite price schedule, effective Sept. 1, 1943

[Per long ton of 2,240 pounds, undried but on dry basis]

Alumina (percent)	Silica (percent)																		
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19			
40.....	\$4.56	\$4.35	\$4.15	\$3.95	\$3.75	\$3.55	\$3.35	\$3.15	\$2.95	\$2.75	\$2.52	\$1.89	\$1.46	\$1.03	\$0.60	\$0.17			
41.....	4.69	4.49	4.29	4.09	3.89	3.69	3.49	3.29	3.09	2.89	2.46	2.03	1.60	1.17	.74	.31			
42.....	4.83	4.63	4.43	4.23	4.03	3.83	3.63	3.43	3.23	3.03	2.60	2.17	1.74	1.31	.88	.45			
43.....	4.97	4.77	4.57	4.37	4.17	3.97	3.77	3.57	3.37	3.17	2.74	2.31	1.88	1.45	1.02	.59			
44.....	5.11	4.91	4.71	4.51	4.31	4.11	3.91	3.71	3.51	3.31	2.88	2.45	2.02	1.59	1.16	.73			
45.....	5.25	5.05	4.85	4.65	4.45	4.25	4.05	3.85	3.65	3.45	3.02	2.59	2.16	1.73	1.30	.87			
46.....	5.39	5.19	4.99	4.79	4.59	4.39	4.19	3.99	3.79	3.59	3.16	2.73	2.30	1.87	1.44	1.01			
47.....	5.53	5.33	5.13	4.93	4.73	4.53	4.33	4.13	3.93	3.73	3.30	2.87	2.44	2.01	1.58	1.15			
48.....	5.67	5.47	5.27	5.07	4.87	4.67	4.47	4.27	4.07	3.87	3.44	3.01	2.58	2.15	1.72	1.29			
49.....	5.81	5.61	5.41	5.21	5.01	4.81	4.61	4.41	4.21	4.01	3.58	3.15	2.72	2.29	1.86	1.43			
50.....	5.95	5.75	5.55	5.35	5.15	4.95	4.75	4.55	4.35	4.15	3.72	3.29	2.86	2.43	2.00	1.57			
51.....	6.09	5.89	5.69	5.49	5.29	5.09	4.89	4.69	4.49	4.29	3.86	3.43	3.00	2.57	2.14	1.71			
52.....	6.23	6.03	5.83	5.63	5.43	5.23	5.03	4.83	4.63	4.43	4.00	3.57	3.14	2.71	2.28	1.85			
53.....	6.37	6.17	5.97	5.77	5.57	5.37	5.17	4.97	4.77	4.57	4.14	3.71	3.28	2.85	2.42	1.99			
54.....	6.51	6.31	6.11	5.91	5.71	5.51	5.31	5.11	4.91	4.71	4.28	3.85	3.42	2.99	2.56	2.13			
55.....	6.65	6.45	6.25	6.05	5.85	5.65	5.45	5.25	5.05	4.85	4.42	3.99	3.56	3.13	2.70	2.27			
56.....	6.79	6.59	6.39	6.19	5.99	5.79	5.59	5.39	5.19	4.99	4.56	4.13	3.70	3.27	2.84	2.41			
57.....	6.93	6.73	6.53	6.33	6.13	5.93	5.73	5.53	5.33	5.13	4.70	4.27	3.84	3.41	2.98	2.55			
58.....	7.07	6.87	6.67	6.47	6.27	6.07	5.87	5.67	5.47	5.27	4.84	4.41	3.98	3.55	3.12	2.69			
59.....	7.21	7.01	6.81	6.61	6.41	6.21	6.01	5.81	5.61	5.41	4.98	4.55	4.12	3.69	3.26	2.83			
60.....	7.35	7.15	6.95	6.75	6.55	6.35	6.15	5.95	5.75	5.55	5.12	4.69	4.26	3.83	3.40	2.97			

percent and totaled 164,234 tons as shipped, dropping almost to the 1941 level. Of the 1944 imports, 580,393 tons came from Surinam, 47,323 tons from British Guiana, and less than 1 ton from Canada, according to the United States Department of Commerce. By customs districts, imports were as follows: 610,114 tons at Mobile, 5,827 tons at New York, 4,134 tons at Philadelphia, 3,839 tons at Massachusetts, 3,802 tons at New Orleans, and less than 1 ton at St. Lawrence.

Bauxite imported into and exported from the United States, 1940-44

Year	Imports for consumption ¹		Exports (including bauxite concentrates) ²		Year	Imports for consumption ¹		Exports (including bauxite concentrates) ²	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1940 . . .	705, 098	\$4, 298, 969	91, 743	\$1, 542, 703	1943 . . .	1, 733, 596	\$10, 860, 149	467, 248	\$5, 575, 128
1941 . . .	1, 260, 532	7, 475, 039	150, 916	2, 773, 877	1944 . . .	627, 716	3, 844, 315	164, 234	2, 928, 799
1942 . . .	990, 323	5, 952, 451	291, 872	5, 086, 695					

¹ Also "alumina" as follows: 1940: 12 tons, \$1,743; 1941: 67 tons, \$5,544; 1942: 24,316 tons, \$1,671,377; 1943: 13,857 tons, \$1,108,104; 1944: Less than 1 ton, valued at \$1.

² Chiefly dried ore.

³ As shipped.

Of the 1944 exports, 147,900 short tons were classified as bauxite and other aluminum ores and 16,334 tons as bauxite concentrates (including alumina). Canada was the largest recipient of the exports, 146,862 tons of bauxite and other aluminum ores being shipped to that country; only 643 tons went to Iran, 394 tons to Curaçao, and 1 ton or less each to Egypt, Algeria, and the United Kingdom. Aside from shipments to Canada, the exports consisted almost entirely of activated bauxite destined for use in oil refineries. Bauxite concentrates (including alumina) were exported to the following countries: Canada 15,866 tons, Trinidad and Tobago 243 tons, Iran 184 tons, Curaçao 40 tons, and U. S. S. R., Brazil, and Mexico each 1 ton or less.

ALUMINUM**PRODUCTION**

Primary.—The production of 776,446 short tons of aluminum metal in 1944—15.6 percent below the all-time record of 920,179 tons set in 1943—resulted in a reverse in a production curve which had climbed steadily for the previous 5 years. The decline in output was due to several cut-backs in plant operation ordered by the War Production Board during 1944, owing to growing stocks of metal and reduced military requirements. Late in the year, however, revisions in military requirements brought about by December reverses on the western front threatened to create a shortage of aluminum in 1945. Early in 1945, accordingly, production was ordered raised 5,000 tons a month by the War Production Board. Total output in 1945 is expected to be at least 10 to 15 percent below that in 1944. In January 1944 the annual rate of aluminum production was 1,017,000 tons, but by December it had fallen to about 560,000 tons.

By far the largest share of the 1944 output was supplied by the five aluminum-reduction plants owned by the Aluminum Co. of America (Alcoa) and the eight plants owned by the Defense Plant Corporation and operated by Alcoa under a management contract. Reynolds Metals Co., with its two plants at Listerhill, Ala., and Longview, Wash., and Olin Corp., operator of the Defense Plant Corporation plant at Tacoma, Wash., supplied the remainder of the domestic output. Approximately 55 percent of the production was from privately owned facilities and 45 percent from Government-owned plants. Of the Alcoa output from its own plants, 40 percent was made at Alcoa, Tenn., 24 percent at Vancouver, Wash., 21 percent at

Massena, N. Y., 9 percent at Badin, N. C., and 6 percent at Niagara Falls, N. Y. Production from the Alcoa-operated Government-owned plants was distributed as follows: 29 percent at Mead (Spokane), Wash., 20 percent at Jones Mills, Ark., 16 percent at Troutdale, Oreg., 13 percent at Queens, N. Y., 11 percent at Los Angeles, Calif., 7 percent at Riverbank (Modesto), Calif., 3 percent at Burlington, N. J., and 1 percent at St. Lawrence (Massena), N. Y. The Listerhill (Ala.) plant of Reynolds Metals Co. supplied 61 percent of Reynolds production, and the Longview (Wash.) plant the remaining 39 percent. The value of the primary aluminum shipped in 1944 averaged 14.32 cents a pound compared with 14.42 cents in 1943 and 14.62 cents in 1942.

Cut-backs in aluminum production ordered by the War Production Board from December 15, 1943, to August 30, 1944, totaled 608,000 ⁴ short tons of annual capacity, leaving only about 560,000 short tons, or 48 percent, of annual installed capacity in operation during the last third of the year. Of the privately owned plants, no cut-backs were ordered for the Reynolds Metals Co. operations, but Alcoa's plants were cut about 29 percent from rated capacity. Production at the Alcoa-operated Defense Plant Corporation plants was cut 75 percent, but at the Olin-operated DPC plant output was left at capacity. Three of the DPC plants are now being used for other purposes—the Queens (Long Island) plant was taken for use by the Navy Department, and the Burlington (N. J.) and Riverbank (Calif.) plants are being used as surplus-property disposal centers by Reconstruction Finance Corporation.

The 500,000-ton Defense Plant Corporation alumina plant at Baton Rouge, La., was closed in the summer of 1944, and substantial cut-backs were ordered at the DPC plant at Hurricane Creek, Ark., and the two Alcoa plants at East St. Louis, Ill., and Mobile, Ala. As a result, production of alumina dropped 63 percent from the peak month of October 1943 to November 1944. Production was increased in December 1944 and early 1945 to assure sufficient supplies of calcined alumina for the 5,000-ton-a-month increase in aluminum metal ordered by WPB early in 1945. The lime-soda-sinter units at the East St. Louis and Hurricane Creek plants went into commercial operation during 1944 to treat the red-mud residues from the Bayer process. It is planned that operation of these units will be enlarged to the point where all the treatable red mud from both plants will be used. Expected recovery of alumina from high-silica domestic bauxites (up to 12.5 percent silica) will be raised from about 70 percent by the Bayer process alone to 85 to 90 percent by the combination process.

The Kalunite, Inc., DPC plant for producing alumina from alunite at Salt Lake City, Utah, has been disappointing in results. Although the plant was substantially complete in the summer of 1943, production has been less than 5 percent of capacity. The small quantity of alumina produced has been shipped to the Olin Corp. aluminum plant at Tacoma, Wash., where test runs have been made on the material in segregated reduction pots. At Salem, Oreg., the Chemical Construction Co. had not yet completed construction for DPC of a plant to use an ammonium sulfate process on Oregon clays. The

⁴ Includes 3 potlines completed but never put into operation because of manpower shortage.

plant is expected to be completed in the fall of 1945, but whether it will operate at that time will depend on the supply situation of ammonium sulfate—now scarce because of agricultural requirements. Anorthosite will be treated in a lime-soda-sinter process to recover alumina in a plant being built for DPC by Monolith Midwest Corp. at Laramie, Wyo. The plant, expected to start operation in September 1945, will also yield a byproduct usable in the cement industry. The lime-sinter soda-leach process plant built for DPC at Harleyville, S. C., by Ancor Corp. began experimental operation in October 1944 and started commercial production of alumina from clay early in 1945.

Pursuant to legislation signed by President Roosevelt on June 10, 1944 (Public Law 332), the Government antitrust case against the Aluminum Co. of America was sent on June 12 to the Second Federal Circuit Court in New York for final action, since four Supreme Court justices had disqualified themselves in 1942. The appeal by the Government to the Supreme Court came after the New York Federal District Court held in 1941 that the Department of Justice had failed to prove its charges that the Aluminum Co. of America had violated the Sherman antitrust law. The appeal was heard by three circuit court judges, who under Public Law 332 sat as a panel of the Supreme Court, and the decision handed down on March 12, 1945, held that the district court had erred in finding that Alcoa had not operated in violation of section two of the Sherman Act. In discussing the Government contention that dissolution of Alcoa should be ordered, the court said:

It is as idle for the plaintiff to assume that dissolution will be proper as it is for Alcoa to assume that it will not be. And it would be particularly fatuous to prepare a plan now, even if we could be sure that eventually some form of dissolution would be proper. Dissolution is not a penalty but a remedy; * * * The need for such a remedy will be for the District Court in the first instance, and there is a peculiar propriety in our saying nothing to control its decision, because the appeal from any judgment it may enter will perhaps be justiciable only by the Supreme Court, if there are then six justices qualified to sit.

Thus, the question of whether Alcoa is to be dissolved eventually was left unsettled. The court recognized, however, that the situation had changed during the war years and, although Alcoa in fact monopolized the virgin ingot market as recently as 1940, it did not follow that this would be true after the war, as the Defense Plant Corporation and the Reynolds Co. held more than 50 percent of the country's aluminum-ingot capacity.

In October 1944 the Department of Justice, acting under the provisions of the Surplus Property Disposal Act, refused to approve the sale of three Defense Plant Corporation-owned aluminum plants to Alcoa on the grounds that such action would contribute to the growth of monopoly. The plants had not been technically declared surplus by the end of 1944, but when they are so declared, Alcoa will not receive consideration as a prospective purchaser.

Negotiations for a new collective bargaining contract between the Aluminum Workers of America, C. I. O., and the Aluminum Co. of America opened on January 20, 1944. The union presented its demands for a 15-cent-an-hour wage increase, a uniform hiring rate of 95 cents an hour, and a uniform wage structure in all plants (that is, elimination of the North-South wage differential) to the War Labor

Board. The union asked that these demands, or any modifications of them directed by the War Labor Board, be made retroactive to January 20 and that the Board rule on this issue before considering the merits of the wage dispute. The Board declined this last demand and stated that the issue of retroactivity would be properly taken up when the dispute was decided. Negotiations and hearings continued throughout the year, and finally on March 28, 1945, a decision was handed down by the War Labor Board including the following: The hourly base pay raise of 15 cents was denied, as was the union demand for a 95-cent-an-hour minimum hiring rate; a union demand for a guarantee of no less than 40 hours' pay for every week in the year was denied; Alcoa was directed to check off union dues up to \$1.50 a month and initiation fees of \$3.00; and the second- and third-shift differentials were raised from 3 and 5 cents to 4 and 6 cents and made retroactive to May 1, 1944.

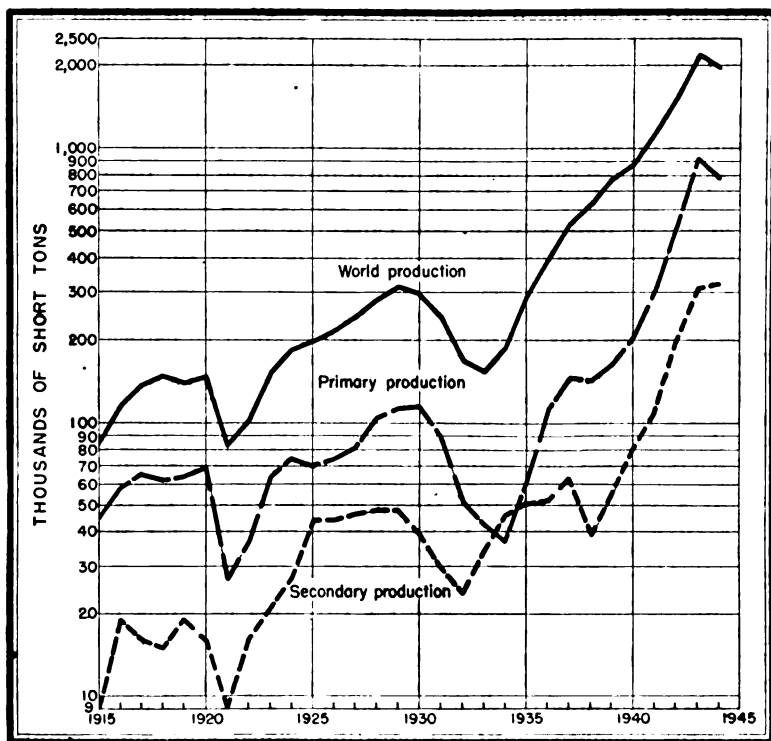


FIGURE 2.—Trends in domestic primary and secondary production and world production of aluminum, 1915-44.

Secondary.—Recovery of secondary aluminum in 1944 totaled 325,645 short tons compared with 313,961 tons in 1943 and 196,464 tons in 1942. The 325,645 tons recovered from secondary sources included 2,336 tons of pure metal (98.5+ percent), 320,040 tons of aluminum alloys, 1,466 tons of aluminum in brass and bronze, 187 tons in zinc-base alloys, and 1,616 tons of aluminum in chemical compounds. Production in the form of secondary ingots totaled 214,879 tons (196,373 tons in 1943). The secondary aluminum

recovered in 1944 required the consumption of 354,182 tons of aluminum scrap, of which 25,223 tons (7 percent) was old scrap (34,266 tons or 10 percent in 1943) and 328,959 tons (93 percent) was new scrap (317,858 tons or 90 percent in 1943). Remelters, smelters, and refineries used 62 percent of this scrap; aluminum rolling mills, 34 percent; and foundries and other manufacturers, 14 percent. Additional information on secondary aluminum is given in the chapter on Secondary Metals—Nonferrous.

CONSUMPTION

Apparent domestic consumption of aluminum in 1944 dropped to 745,998 short tons—15 percent below that in 1943 (877,381 tons).

No statistics on aluminum consumption are available, and therefore no precise appraisal of total actual consumption or consumption by use can be made. However, data on shipments of aluminum, including both primary and secondary metal in ingot, semifabricated, and fabricated form are gathered by the War Production Board in connection with its job of regulating supply and of allocating the available supply to various claimant agencies under the Controlled Materials Plan. These data indicate that, of the shipments for domestic use, approximately 64 percent was destined for aircraft construction, 21 percent for Army and Navy use, and 15 percent for other uses including essential civilian uses.

Aluminum is used in aircraft construction mainly in air frames, landing gear, engines, propellers, and fittings. The importance of the metal to the heavy-bomber program is indicated in a statement by Alcoa to the effect that a B-29 Superfortress requires more than 50,000 pounds of aluminum, including 23,000 pounds of sheet, 18,000 pounds of extruded shapes, 550 pounds of tubing, 150 pounds of rod, bar, and wire, 750 pounds of rivets, 2,000 pounds of castings, 400 pounds of forging, and approximately 6,500 pounds in engine parts and miscellaneous applications. During 1944, 96,369 planes of all types were delivered to the armed forces, and the average total weight per plane was 10,600 pounds; it is estimated that at least 50 percent was aluminum or aluminum alloys.

Tank engines, ordnance, airplane landing mats, and ship construction consumed the bulk of the shipments for Army and Navy use. Among naval units, an aircraft carrier uses the most aluminum, requiring about 2,000,000 pounds. Next are battleships, using about 1,400,000 pounds each, followed by heavy cruisers, 600,000 pounds; light cruisers, 500,000 pounds; destroyers, 225,000 pounds; large auxiliary ships, 60,000 pounds; small auxiliary ships, 20,000 pounds; and submarines, 15,000 pounds. Airplane landing mats, weighing about one-half as much as the older steel-type mat, and aluminum gasoline drums, weighing 21 pounds each, as compared with 52 pounds for those of other materials, were new military applications of aluminum in 1944. Another interesting and important use of the metal during the year was the thin strips of aluminum foil dropped from bombers and fighter planes over enemy territory to confuse the enemy's radar-directed anti-aircraft batteries.

The remainder of the shipments of aluminum during 1944 were largely destined for indirect military and essential civilian uses.

Among the authorized uses of the metal were the following: Box and hopper railroad cars, trucks and busses, chemical equipment, steel deoxidizing, foundry equipment, foil for wrapping purposes, collapsible tubes, metal containers (including cans), aluminum paint, cooking utensils, food-processing machinery, and domestic laundry equipment. The relaxation of controls over aluminum in midyear did not result in greatly increased consumption for civilian consumer goods, largely because manpower difficulties often prevented manufacture even when metal was available. In the latter part of 1944 a number of "Z" allotments—deferred authorization contingent on the availability of aluminum—were granted by the War Production Board for civilian goods manufacture, but only a relatively few deliveries were made.

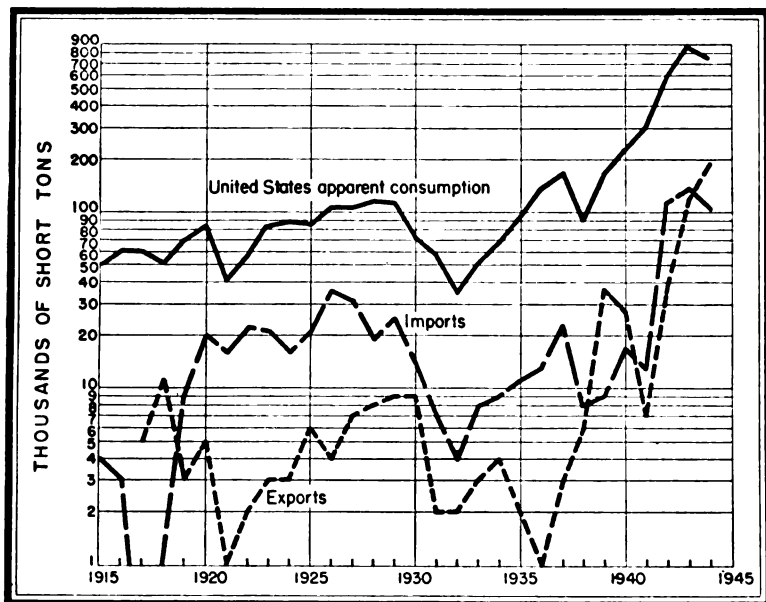


FIGURE 3.—Trends in imports, exports, and apparent consumption of aluminum, 1915-44.

Production, imports, exports, and apparent consumption of primary aluminum and production of secondary aluminum in the United States, 1940-44

Year	Primary aluminum					Secondary aluminum	
	Production		Imports (short tons)	Exports (short tons)	Apparent consumption ¹ (short tons)	Short tons	Value ²
	Short tons	Value					
1940.....	206,280	\$75,292,000	17,435	26,886	227,017	80,362	\$29,332,130
1941.....	309,067	100,395,000	13,358	7,405	302,788	106,857	34,707,153
1942.....	521,106	151,371,000	112,112	38,747	588,669	196,464	57,446,074
1943.....	920,179	265,380,000	135,581	117,592	877,381	313,961	90,546,352
1944.....	776,446	222,416,000	102,753	188,521	745,998	325,636	93,262,140

¹ Data not available on fluctuations in consumers' stocks. Withdrawals from producers' stock totaled 30,188 tons in 1940 and 55,320 in 1944; additions to producers' stocks totaled 12,232 tons in 1941, 5,502 in 1942, and 60,787 in 1943.

² Based upon average price of primary aluminum as reported to Bureau of Mines.

PRICES

During 1944, as in the previous 2 years, the New York open-market base price of primary aluminum remained at 15 cents a pound for lots of 10,000 pounds or more, 99-percent-plus virgin ingot aluminum, delivered. Pig aluminum remained at 14 cents, delivered, throughout 1944 for 99-percent-plus pigs. Quoted prices for remelted pig, 97.5 percent pure, delivered, ranged from 11 cents to 12.5 cents a pound and averaged 11.733 cents for the whole year. Remelted No. 12 alloy, delivered, ranged from 9.25 to 10.5 cents a pound and averaged 10.226 cents in 1944.

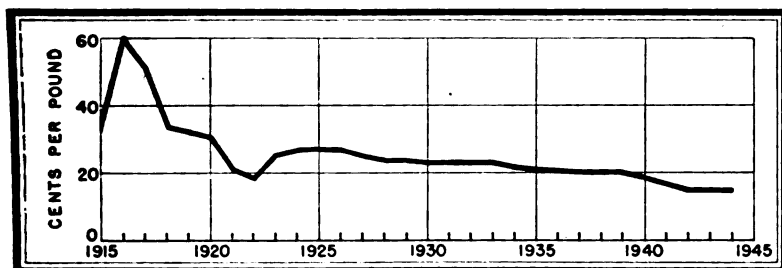


FIGURE 4.—Trend in average quoted price of aluminum, 1915-44. Price is for No. 1 virgin 98-99 percent at New York through 1929. Thereafter for 99-percent-plus virgin ingot, as reported by American Metal Market.

FOREIGN TRADE

Imports of crude and semicrude aluminum in 1944 decreased 24 percent in tonnage and 27 percent in value from those in 1943 and amounted to 102,753 tons valued at \$30,229,982. On the other hand, exports of crude and semicrude aluminum increased 60 percent in quantity and 25 percent in value over 1943, reaching an all-time high mark of 188,521 tons valued at \$73,578,734. The value of exports of manufactured aluminum products increased 106 percent, whereas the value of imports decreased 82 percent in 1944. Imports of aluminum (crude metal and alloys only) constituted 13 percent of the ap-

Aluminum imported for consumption in the United States, 1942-44, by classes

Class	1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value
Crude and semicrude:						
Metal and alloys, crude.....	106,257	\$33,289,903	135,505	\$41,170,788	100,315	\$29,736,189
Scrap.....	24	6,737	241	30,364	1,784	145,063
Plates, sheets, bars, etc.....	5,855	2,204,331	76	102,117	654	348,740
	112,136	35,500,971	135,822	41,303,269	102,753	30,229,982
Manufactures:						
Bronze powder and powdered foil.....	(¹)	4	(¹)	73	20	16,887
Foil less than 0.006 inch thick.....	(¹)	37	(¹)	36	31	35,716
Table, kitchen, hospital utensils, etc.....	(¹)	91	4	7,253	1	2,631
Other manufactures.....	(²)	1,646,788	(²)	506,413	(²)	37,437
	(²)	1,646,920	(²)	513,775	(²)	92,671
Grand total.....	(²)	37,147,891	(²)	41,817,044	(²)	30,322,653

¹ Less than 1 ton.

² Quantity not recorded.

parent consumption of primary aluminum in 1944. All of the reported imports of crude metal, scrap, and plates, sheets, and bars came from Canada except 24 tons of scrap from Mexico.

Of the crude aluminum exported in 1944 (133,089 short tons), 127,187 tons went to U. S. S. R., 2,097 to Brazil, 2,095 to the United Kingdom, 1,185 to Canada, 295 to Mexico, 61 to Uruguay, 43 to Chile, 37 to Colombia, 33 to Eire, 23 to Cuba, 14 to Australia, and less than 10 tons each to China, Belgian Congo, Venezuela, Bahamas, Haiti, New Zealand, French Morocco, and Egypt; of semicrude (55,019 tons), 28,375 tons went to U. S. S. R., 24,314 to the United Kingdom, 1,657 to Canada, 333 to Brazil, 136 to Australia, 39 to Northern Rhodesia, 30 to Cuba, 27 to Chile, 24 to China, 13 to Peru, 11 to French Morocco, and less than 10 tons each to New Zealand, Honduras, Costa Rica, Ecuador, Argentina, Mexico, Union of South Africa, Nicaragua, Turkey, Egypt, Venezuela, Colombia, Bahamas, Uruguay, Iceland, Trinidad, Curaçao, Azores, and Southern Rhodesia, and less than 1 ton each to 13 additional countries; and of scrap (413 tons) 232 tons went to Canada, 108 to Mexico, and 63 to Brazil.

Aluminum exported from the United States, 1942-44, by classes

Class	1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value
Crude and semicrude:						
Ingots, slabs, and crude.....	17,834	\$5,514,562	56,741	\$19,111,522	133,089	\$39,027,310
Scrap.....	32	1,157	14	3,216	413	54,466
Plates, sheets, bars, etc.....	20,913	14,046,933	60,861	39,959,650	55,019	34,496,958
	38,779	19,562,652	117,606	59,074,397	188,521	73,578,734
Manufactures:						
Tubes, moldings, or other shapes.....	3,398	5,406,137	4,131	4,593,838	5,224	7,999,206
Table, kitchen, and hospital utensils.....	138	161,806	32	54,342	25	40,383
Foil.....	129	121,800	576	474,605	1,634	1,411,531
Powders and pastes (aluminum and aluminum bronze) (aluminum content).....	1,314	651,802	2,794	1,402,940	12,448	5,489,895
Other manufactures.....	(¹)	1,044,489	(¹)	1,568,674	(¹)	1,800,692
	(¹)	7,386,034	(¹)	8,124,399	(¹)	16,741,707
Grand total.....	(¹)	26,948,686	(¹)	67,198,796	(¹)	90,320,441

¹ Quantity not recorded.

TECHNOLOGIC DEVELOPMENTS

The Alcoa combination process for the recovery of alumina from high-silica bauxite was used successfully during 1944 at the Hurricane Creek and East St. Louis alumina plants. By re-treating red-mud residues from high-silica bauxite a recovery of 85 to 90 or more percent of the total alumina contained in the ore is obtained, whereas the same ore treated only by the Bayer process would show a recovery of about 70 percent. A new alumina development laboratory⁵ of Aluminum Research Laboratories at the East St. Louis (Ill.) works of the Aluminum Ore Co., which was designed and built at a cost of \$750,000.

⁵ Chemical Industries, Alcoa's New Aluminum Development Laboratory, January 1945, pp. 54-58.
 Edwards, J. D., The Combination Process for Alumina: Metals Technol., vol. 12, No. 3, Tech. Pub. 1833, April 1945, 6 pp.

was completed in 1944. The newly completed laboratory includes pilot-plant facilities for the development of improved operating technique, economy in use of materials, and improved quality of product in the Alcoa combination process. Aluminum Research Laboratories has been working on methods of recovering alumina from low-grade aluminous materials for a number of years and had developed the lime-soda-sinter process for recovering both alumina and caustic from Bayer-plant waste. Because of the urgency for maximum production of alumina—for which a large proportion of domestic bauxite had to be used—it was necessary to build the pilot plant and the four commercial units⁶ concurrently.

As commercial operation at the large sinter units now being used does not permit adequate experimental work necessary to develop the process to its full value, the data and experience to be obtained from the pilot plant will have great value. The laboratory is equipped with a complete Bayer unit on a small scale which can be operated separately or in combination with various waste-recovery processes.

In the combination process Bayer-process waste or red mud is sintered with a slight excess of limestone and soda ash over that necessary to combine with the silica and alumina, then leached with a caustic soda solution to give a solution of sodium aluminate and caustic soda which is returned to the digester circuit. The process is said to be so effective when used with the Bayer process on high-silica ores that the proportion of alumina recovered from bauxite containing 10 to 15 percent silica is as high or higher and the soda loss lower than in the Bayer process alone operating on high-grade bauxite. The combination process appears to open up the possibility that domestic low-grade bauxite may be as economical as imported bauxite when the inland plants at Hurricane Creek and East St. Louis are considered. The lime-soda-sinter process is definitely to be classed as one of the major technologic advances of the past decade in the aluminum industry.

Military demand for bombers of longer range and greater load-carrying capacity and for higher-performance combat planes has stimulated the search for stronger aluminum alloys. Alcoa alloy X76S, a heat-treatable alloy with magnesium and zinc as the principal alloying ingredients, was announced in 1944, though it had been in use for forged-aluminum propellers for 3 or 4 years.⁷ During 1944 another alloy, 75S was put into commercial production in the form of extrusions and aluminum-clad sheet. Magnesium, zinc and copper are the main alloying ingredients. Extrusions have a tensile strength of 80,000 p. s. i. (pounds per square inch) and a yield strength of 88,000 p. s. i., or about 50 percent above the best high-strength aluminum alloys formerly obtainable. A new Reynolds alloy, R-303, is an aluminum-magnesium-zinc alloy with high tensile and yield strength. Other important developments have been the introduction of two alloy-clad sheet alloys, R-301 and 14S. All five alloys are finding important applications in the manufacture of military aircraft.

⁶ At Baton Rouge, La.; Mobile, Ala.; Hurricane Creek, Ark.; and East St. Louis, Ill.

⁷ Edwards, J. D., Aluminum Alloys (Wrought): Metals and Alloys, vol. 21, No. 1, January 1945, p. 91.

WAR MEASURES

War Production Board Conservation Order M-1-i, which governed all uses of aluminum other than scrap, and paint and pigment, was amended March 24 and July 15, 1944, to relax its restrictions somewhat and finally was revoked on August 15, 1944. On the same date the Board's Limitation Order M-1-k was issued, specifically removing restrictions on all the uses of aluminum, exclusive of those provided for in regulations under the Controlled Materials Plan, and Orders M-1-d (scrap) and M-1-g (aluminum, paint and pigment), except that household and kitchenware might be made only as described in Order L-30-e, and restrictions established by other War Production Board orders as to quantity, size, and type of articles manufactured would remain. In spite of this apparent concession to the manufacturers of civilian goods from aluminum, Priorities Regulation 25, also issued August 15, stated that civilian production could proceed only where manpower and facilities were available and not needed for essential war purposes. As a result, production of civilian consumer goods late in 1944 was not greatly increased by the revocation of Order M-1-i, but its effects probably will be felt in an increase in the manufacture of aluminum goods for civilians during 1945.

Order M-1-d, covering scrap aluminum, as amended September 22, 1944, provides only that all persons dealing in scrap shall keep records and make reports to the War Production Board and that special directions may be issued by the Board relative to use, receipts, delivery, and segregation of scrap.

Order M-1-g, relating to aluminum paint and pigment, as amended September 11, 1944, requires only that persons seeking to obtain aluminum pigment shall apply to the War Production Board and that no producers shall deliver it except on orders authorized by the Board, except under Order P-43 (research, developmental, or experimental purposes).

The distribution of aluminum during 1944 continued to be governed by the Controlled Materials Plan, by which production programs of claimant agencies are adjusted to conform with available supply and allotments are granted to claimant agencies in the quantity and forms necessary to meet authorized programs and schedules.

On October 23, 1944, General Preference Order M-1-h allocating bauxite and alumina was revoked. These commodities are now free of restriction as to use, since the available supply exceeds requirements.

POSTWAR OUTLOOK

Present productive capacity in the aluminum industry, expanded some seven times since 1939, has proved large enough to satisfy all military and essential civilian needs during the war period, even without full operation at any time. By the end of 1944 all needs were being filled, with output at only about half of total rated annual capacity. The realization that even full wartime demand has not required the use of all aluminum-producing facilities has stimulated considerable thought about the prospects of the industry during the postwar years. Unlike most other metals, aluminum has been lowered 25 percent in price during the war period and is now sold for

15 cents a pound in ingot form. Available data indicate that all of the privately owned production facilities in the country—about half of the total—can produce the metal at a profit at its present price and that perhaps 50 percent of the Government-owned capacity can meet the present price. The postwar period may bring further reductions in price, although this is by no means assured. One certainty is that, with respect to cost, aluminum has been considerably improved in relation to other metals during the war and that much if not all of this relative gain can be held. Among the major industrial metals aluminum appears to have established itself in a strong position for greatly enlarged use in the postwar years, compared with the prewar period.

The disposition of the large stocks of metal in ingot, semifabricated, and fabricated form, which are likely to be on hand at the end of hostilities, is an important factor to be considered in evaluating postwar production of new aluminum. Stocks on hand, including metal in process at aircraft plants and other consumers, metal in the hands of scrap dealers, metal in plant inventories and in process in the aluminum industry, and Government stock piles, were estimated to total over 1,000,000 tons early in 1945. Dumping any substantial part of this metal on the market would cause serious hardship to the aluminum-production industry. It is possible that if prompt action is taken under section 22 of the Surplus Property Act of 1944 (Public Law 457—78th Cong.) a large share of this quantity could be held in a strategic stock pile as a protection against any future emergency. However, the freezing provisions of this bill expire January 2, 1946, and unless Congress extends the provisions of this section of the act or enacts other stock-pile legislation, the postwar surpluses of aluminum will weigh heavily on postwar markets.

Consumption of aluminum and aluminum products in the immediate postwar years probably will be relatively large in those industries that will have a pent-up demand accumulated during the war such as that for cooking utensils and other small consumer items, although total consumption is expected to drop sharply from the war period because airplane construction and other wartime uses will experience an abrupt decline. After the immediate readjustment period, consumption of aluminum will increase in the larger heavy industries, including building construction, railroad rolling stock, and truck, bus, and possibly automobile manufacture. Resumption of civilian plane construction, both private and commercial, will also require aluminum, but it is not likely that this use will be a major factor in the aluminum industry for several years. A steady demand for a moderate number of military aircraft, if national policy should demand maintenance of a powerful air force, would be a major outlet.

Estimates of consumption of primary aluminum by the fourth or fifth year after the war have varied widely and range from 250,000 to more than 700,000 tons, assuming a price of 15 cents a pound. At lower prices, of course, use of aluminum would rise in products where its competitive position with other materials is very close. In certain industries, such as bus, railroad equipment, and aircraft manufacture, where light weight is a controlling factor, small price changes would have little effect on total use, since long-term operating costs are more important than first cost. In other industries, however, where first cost is a more important factor, such as the automobile, cooking

utensil, washing machine, electrical appliance, and building construction, the consumption of aluminum would be greatly affected by fluctuations in price.

Bauxite, the raw material from which virtually all aluminum is produced, is found in abundant quantities throughout much of the world, but domestic reserves of high grade are very limited. Lower grade bauxites, for which extraction processes have been developed during the war, occur more abundantly in the United States but still represent a limited resource. It seems likely that a large share of the bauxite consumed to make aluminum after the war will be imported from South American and Caribbean areas, where reserves are very large. If these sources of supplies should be cut off for any reason, domestic bauxites and possibly clays could supply domestic needs in an emergency. Such reliance on domestic higher-cost resources might be reflected in the price of aluminum, but its effect on the final cost of finished products made from the metal would be very slight.

The United States will continue to occupy an important position in the world aluminum industry after the war. Although it is doubtful if the domestic industry can compete favorably in the world market for ingot metal with many foreign producing countries, particularly Canada, it seems relatively certain that with American mass-production techniques and low unit cost of fabricated products, articles made from aluminum, such as cooking utensils and other items, can compete to advantage in many foreign markets.

WORLD BAUXITE AND ALUMINUM INDUSTRIES

World production of bauxite and aluminum in 1944 decreased greatly from 1943, partly because of overproduction and decreased demand in certain of the United Nations and partly because of bombings, transportation disruptions, and invasions in certain of the Axis countries. Output during 1945 is expected to be somewhat less than in 1944.

World production of bauxite is estimated to have totaled 6,953,000 metric tons in 1944—a drop of 48 percent from the all-time record of 13,247,300 (estimated) in 1943 and only slightly above the production in 1941. The bulk of the decrease is accounted for by a large drop in production in the Western Hemisphere—approximately 5,500,000 tons—owing to cut-backs in metal production in the United States and Canada and to large stock piles of ore in the United States. Of the world output in 1944, it is estimated that 1,936,700 tons (28 percent) were produced in Axis-controlled areas, whereas 5,014,200 tons (72 percent) were produced in areas under control of the United Nations. The balance of 2,500 tons was produced in neutral areas.

The 12-percent decrease in the estimated world production of aluminum in 1944 is largely accounted for by cut-backs in Canada, United States, and the United Kingdom. Some decrease was noted among the Axis-controlled areas—notably France and Italy—as a result of air bombardment and reconquest by the Allies. It is estimated that approximately 505,000 metric tons or 29 percent of the total aluminum was produced in Axis-controlled areas, 1,230,976 tons or 70.6 percent in areas of United Nations control, and 7,706 tons or 0.4 percent in neutral countries.

World production of bauxite, 1940-44, by countries, in metric tons

[Compiled by B. B. Waldbauer]

	1940	1941	1942	1943	1944
Australia:					
New South Wales.....	2,081	2,671	1,832	(1)	(1)
Victoria.....	1,446	2,793	1,655	1,855	1,842
Brazil.....	82	14,365	29,890	276,761	5,000
British Guiana.....	634,510	1,080,979	1,215,744	1,919,060	928,178
France.....	489,020	587,420	639,560	916,350	665,638
Germany.....	20,000	25,000	25,000	25,000	25,000
Gold Coast.....		15,000	45,000	163,000	110,000
Greece.....	50,000	50,000	50,000	25,000	10,000
Hungary.....	650,000	650,000	700,000	800,000	800,000
India, British.....	15,000	13,170	18,551	20,000	25,000
Indochina.....	118	1,000	1,000	1,000	1,000
Italy.....	530,000	600,000	400,000	300,000	100,000
Jamaica.....				2,500	
Japan (mandated islands).....	43,000	50,000	50,000	50,000	25,000
Netherlands Indies.....	274,345	171,821	250,000	300,000	200,000
Portuguese East Africa.....	1,030	1,352	1,860	3,272	3,000
Rumania.....	40,000	40,000	40,000	12,000	10,000
Southern Rhodesia.....		1,000	1,000	1,000	1,000
Spain.....	271	1,383	2,214	2,400	2,500
Surinam.....	615,434	1,198,900	1,227,512	1,655,147	625,804
United Federated Malay States (Johore).....	63,787	75,000	75,000	60,000	50,000
U. S. S. R.....	300,000	250,000	275,000	350,000	400,000
United Kingdom.....		40,000	100,000	110,000	45,000
United States (dried equivalent) 4.....	446,253	952,082	2,643,775	6,332,868	2,869,021
Yugoslavia.....	290,000	400,000	200,000	120,000	50,000
	4,466,400	6,204,000	7,994,600	13,247,200	6,953,000

1 Data not available..

2 Exports.

3 Estimated production. Estimates by authors.

4 Figures changed to represent actual mine production of crude ore.

World production of aluminum, 1940-44, by countries, in metric tons

[Compiled by B. B. Waldbauer]

	1940	1941	1942	1943	1944
Canada.....	99,064	192,594	304,631	1,447,000	1,418,000
France.....	61,740	63,915	45,224	46,000	26,000
Germany 1.....	240,000	240,000	275,000	310,000	300,000
Hungary.....	2,800	5,000	7,000	12,000	14,000
India.....			500	1,300	1,600
Italy.....	40,000	50,000	50,000	42,000	20,000
Japan.....	40,000	65,000	82,000	110,000	130,000
Norway.....	15,000	12,000	19,000	27,000	15,000
Spain.....	1,295	1,120	742	797	206
Sweden.....	2,276	2,500	2,000	3,600	2,500
Switzerland.....	20,000	25,000	22,000	17,500	5,000
U. S. S. R.....	68,000	62,000	57,000	65,000	71,000
United Kingdom.....	19,300	23,370	47,750	56,890	36,000
United States.....	187,100	280,383	472,737	834,768	704,376
Yugoslavia.....	2,400	2,200	2,000	1,500	(1)
	799,000	1,025,100	1,387,600	1,974,400	1,743,700

1 Estimated production. Estimates by the authors.

2 Includes Austria.

REVIEW BY COUNTRIES

Brazil.—After prolonged delays owing to difficulties in obtaining equipment and in solving technical problems, the Companhia Electro-Chimica Brasileira finally began production at its alumina and aluminum plants near Ouro Preto, Minas Gerais, in April 1945. This is

the only one of several aluminum projects in Brazil that has proceeded beyond the planning stage. Capacity of the metal plant has been variously estimated at 2,000 to 2,500 tons annually, and capacity figures for the alumina plant have ranged from 6,000 to 10,000 tons annually. The bauxite used at the alumina plant is obtained from nearby deposits and is said to contain about 54 percent Al_2O_3 and to have a low silica content. Power from a hydroelectric plant located a few kilometers away is said to be supplied at a cost of 3 to 3.5 mills per kilowatt-hour, allowing for amortization of the facilities over a 30-year period. The anticipated annual production of 2,000 to 2,500 tons will be sufficient to satisfy Brazil's domestic needs if they are near the prewar level. The quantity of bauxite produced during 1944 is not known but probably was about 5,000 tons. Exports totaled 2,979 tons, of which 1,250 tons were shipped to Argentina for alum manufacture, 1,699 tons were sent to the United Kingdom, and 30 tons were destined to Chile.

British Guiana.—Exports of bauxite in 1944 dropped to about 40 percent of the 1943 total and averaged less than 78,000 tons a month. The decline in both production and exports was due to decreased demands from Canada and the United States and to reduced shipping quotas necessitated by a shortage of bottoms. Since bauxite mining is the most important industry in the colony, the large decrease in output affected revenues greatly. The Demarara Bauxite Co., with its mines at Mackenzie City, was the only company operating during 1944, since the Berbice Bauxite Co., Ltd. (a subsidiary of American Cyanamid & Chemical Corp.), had ceased mining at its properties late in 1943.

Canada.—Owing to curtailed war demands and decreased export requirements for Great Britain and the United States, production of ingot aluminum in the province of Quebec, Canada, in 1944 declined about 7 percent from the record high mark reached in 1943. Late in November 1944 the Aluminum Co. of Canada announced that it would curtail production about one-half by December 10. It was announced that about 2,500 workers would be laid off as a result of the cut-back. Officials of the company stated, however, that they did not expect production of metal to fall to the prewar level, even temporarily. The export sales organization of the company is actively rebuilding to establish new peacetime foreign outlets. Undoubtedly, the United Kingdom will continue to be a good customer for Canadian metal, but the large wartime exports to the United States will not continue after the war.

China.—According to a recent report,^a the first bar of primary aluminum produced in Free China was displayed at the Chinese Government Industrial and Mining Exhibition in 1944. The metal was produced in December 1943 in an experimental plant in Yunnan Province, which has a capacity of about 1 ton a day. It is reported that negotiations for the construction of two reduction plants are taking place.

Dominican Republic.—According to reliable sources, geologists of the Republic Mining & Manufacturing Co. have been conducting exploratory work for bauxite deposits in the central part of Barahona Province. The Reynolds Metals Co. is understood to have aban-

^a Chang, T. Y., *China's Cinderella Industry*: Min. Jour. (London), vol. 222, No. 5686, Aug. 12, 1944, p. 490.

doned its work in the country. On May 3, 1944, the National Congress of the Dominican Republic passed Law 575, specifying conditions under which contracts may be made between the Government and private individuals or companies for exploration and exploitation of lands containing bauxite and other aluminous materials. This law stated that a tax of 10 cents per hectare annually and a royalty of 10 cents per ton of ore extracted would be levied by the Government and that contracts would be valid for not more than 30 years but would be renewable.

France.—Reliable data concerning the French bauxite and aluminum industries during the period of German occupation show that bauxite production was considerably lower in 1940 and 1941 than had been previously believed, whereas the estimated metal output during these years was very close to the actual figures. A sharp rise in bauxite production in 1943 reflects the efforts of the Nazi Todt Organization to stimulate output after the occupation of southern France in November 1942. The production rate was increased again during early 1944, but the output fell to about the 1942 level for the whole year, inasmuch as mining had virtually ceased after August 15. Domestic consumption of bauxite, as indicated by shipments from mines to French industry, was virtually constant at 420,000 to 450,000 tons annually from 1940 through 1943. Shipments declined sharply in 1944 owing to the drop in mine output and to the paralysis of transport facilities in the latter third of the year. Deliveries of bauxite to Germany rose from none in 1940 to about 230,000 tons in 1941 and 1942. After the occupation of southern France, deliveries were greatly accelerated and totaled about 480,000 tons in 1943 but dropped to less than 300,000 tons in 1944.

Efforts by the Nazis to stimulate production of aluminum were not as effective as for bauxite. French aluminum output reached a record high of about 64,000 tons in 1941 but declined about 25 percent in 1942 and 1943. Production in 1944 totaled less than half the 1940 output owing to virtual cessation of operation in August.

On January 1, 1945, bauxite stocks in France totaled about 350,000 tons, which is thought to be adequate for domestic requirements in 1945. Before the war domestic consumption of French bauxite was distributed as follows: 91.5 percent for aluminum, 3.8 percent, for abrasives, 2 percent for refractories, 1.5 percent for cement, and 1.2 percent for other uses. Only two French bauxite mines, representing about 3 percent of the total output, were damaged during the war—the Saint-Christophe mine at Vins in the Var and the Rouenmale mine in Hérault.

It is believed that damage to alumina and aluminum plants during the war was relatively slight and that necessary repairs have already been nearly completed. Production of aluminum during 1945 depends largely on the speed with which transport can be reorganized and on the availability of coal.

Germany.—German and Austrian aluminum production in 1944 is estimated at about 300,000 metric tons. Although annual capacity of plants in the two countries was probably 350,000 to 400,000 tons in 1944, it is extremely doubtful if the industry was able to approach capacity output in the face of Allied air raids. Transportation and power difficulties must have been almost insurmountable during the nearly continuous bombing raids, and the labor situation

was undoubtedly difficult. With the loss during 1944 of France and part of the Yugoslav Adriatic coast, Germany was cut off from two important bauxite sources.

Gold Coast.—The bauxite boom in Gold Coast, which reached its peak during 1943, appears to be definitely on the wane, and 1944 production dropped 33 percent from that of the previous year. Cut-backs in British aluminum reduction plants meant reduced need for bauxite and consequent reductions in shipping space allocated to carry the ore from Takoradi to Great Britain. The high mining costs and the long rail haul from mine to port make the outlook poor for Gold Coast bauxite after the war.

Haiti.—According to reliable sources, the Ste. Croix area is said to contain at least 10,000,000 tons of bauxite. Other smaller deposits have been located, but present indications are that only the Ste. Croix area has large enough reserves of commercial ore to be exploited under present conditions. Samples of Haitian bauxite show a range of 30 to 52 percent available alumina; 21 to 25 percent ferric oxide; and 1 to 10 percent silica. The ore is said to have been formed from the weathering of limestone and is a red, friable, claylike material.

India.—The Indian Aluminium Co., Ltd. (formerly the Aluminium Production Co. of India, Ltd.), was the only active producer of ingot aluminum in India during 1944, according to reports. The output of primary metal by this company from its plant at Alwaye, Travancore, is estimated to have been about 1,600 metric tons in 1944, and reported plans are that ultimately capacity will be raised to 5,000 tons annually. In the near future the Indian Aluminium Co., Ltd., expects to begin production of alumina from a plant now under construction at Ranchi in Bihar Province. Nearby bauxite deposits will supply the raw material for the plant and are reported to have a minimum Al_2O_3 content of 52 percent and an SiO_2 content of less than 5 percent. This company also owns and operates a sheet rolling mill at Calcutta and will thus have an integrated operation upon completion of its alumina plant at Ranchi.

The Aluminium Corporation of India, Ltd., also plans to have an integrated operation in Asansol, Bengal, where its alumina plant is already in limited operation. The ingot plant and rolling mill now under construction by this company are expected to produce in 1945.

Jamaica.—Aluminium, Ltd., of Canada, through its subsidiary, Jamaican Bauxite, Ltd., is reported to have acquired important bauxite properties in Jamaica. Work has been carried on since 1942 in exploration of these deposits which is expected ultimately to lead to the development of mines and a drying plant to supplement Canada's present source of supply—British Guiana. Reynolds Metals Co. announced the development of long-range plans for mining bauxite in Jamaica, but predicted that operations were unlikely to begin until after the war. The company has acquired holdings in several parishes on the island.

Japan.—According to reports from Japan, bauxite deposits have been recently discovered in Kagawa on Shikoku Island, and the Japanese industry is reported to have begun their exploitation. The deposits are reported to have ore containing about 40 percent alumina.

Mexico.—A company known as Alumino Industrial Mejicano, S. A., has been formed by Aluminium, Ltd., of Montreal, Canada. The company has acquired land near Mexico City and is erecting an

aluminum sheet mill which will be the first part of an ultimate 5,000-ton fabricating enterprise.

Nigeria.—West African Aluminium, Ltd., was recently formed with a nominal capital of £250,000 as a subsidiary of Anglo-Transvaal Consolidated Investment Co., Ltd., to exploit bauxite deposits in Nigeria.

Spain.—Aluminum production in Spain dropped to 206 tons in 1944 owing to an acute power shortage and inability to import sufficient alumina. Official annual production statistics have been made public in *Estadística Minera y Metalúrgica de España*, Spain's official publication of metal and mineral statistics, for the first time since before the war. Normal Spanish requirements of aluminum are said to be approximately 3,500 tons a year, and thus imports have been necessary to aluminum-consuming industries in recent years. During 1944, 1,050 tons of pig aluminum were imported, in addition to some metal in fabricated and semifabricated form. Normal productive capacity of the plant of the Sabinanigo plant of Soc. General Española de Aluminio is reported to have been raised to 2,700 metric tons annually, and plans for at least one other reduction plant have been formulated but were not believed to have been carried out by the end of 1944. Top production for this country during the past decade was in 1940, when 1,295 tons of aluminum were produced.

Surinam (Dutch Guiana).—Bauxite production in Surinam decreased 62 percent in 1944, totaling 625,804 metric tons as compared with 1,655,147 tons in 1943. The Surinamsche Bauxite Maatschappij produced 83 percent of the total, or 517,707 tons, and the remaining 17 percent, or 108,097 tons, was mined by the N. V. Billiton Maatschappij. Both mines of Surinamsche Bauxite Maatschappij at Moengo, about 105 miles east of Paramaribo on the Cottica River, and Paranam, about 30 miles south of Paramaribo on the Surinam River, and the mine of the N. V. Billiton Maatschappij at Smalkalden on the Para River were in operation throughout 1944. It is understood that the Billiton mine will be closed down in 1945. Lowered exports, paralleled by decreased production, were due to reduced shipping quotas and scarcity of bottoms as well as to lessened need for bauxite in the United States and Canada. Present indications are that 1945 production will be at or near the same level as that in 1944.

Sweden.—On March 1, 1944, the Swedish Industrial Commission removed all restrictions on the sale of aluminum and its alloys, including scrap. This action reflects the improved position of the country in respect to aluminum as a result of the successful operation of the Kubikenborg alumina plant and the release of State-owned reserve of aluminum metal. Sweden is now self-sufficient in aluminum raw materials; cryolite is produced synthetically, and alumina is made from andalusite by the Pedersen process.

United Kingdom.—Early in 1945 the British Ministry of Aircraft Production announced a reduction of £25 per long ton in the price of aluminum in Great Britain. The new price is £85 and represents the first official price change since 1939, when aluminum was pegged at £110. This action brings the British aluminum price down to an equivalent of 15.3 cents per pound, based on the official Bank of England sterling rate of \$4.035, compared with the present United States price of 15 cents a pound for virgin ingot and 14 cents a pound

for pig aluminum. Announcement was made of the formation of the Aluminium Development Association, comprising alloy producers and fabricators whose objective is to develop new and expanded uses for aluminum alloys by encouraging research and disseminating information to the British public concerning the many uses to which aluminum can be put.

Production of aluminum in the United Kingdom in 1944 is estimated to have decreased 37 percent from 1943, owing to cut-backs during the year. The 1943 output of aluminum—nearly 57,000 tons represented an all-time record for the domestic industry. R. N. Cooper, chairman of the board of the British Aluminium Co., Ltd., reviewed some of the wartime activities of the company and said that the increased metal output was accomplished by completion of the Lochaber facilities, by increasing capacity at Kinlochleven, and by erecting and operating for the Government a plant using steam-generated power. The company was also associated in two other developments using transmitted power for aluminum reduction. All reduction units of the company except those at Lochaber were forced to shut down in 1944 because of the coal situation, and there does not appear to be much likelihood of their being put back in production in the near future. The company alumina plant at Newport was materially enlarged during the war period, and minor changes were made at the Burntisland and Larne plants. The rolling mills at Milton and Warrington were greatly enlarged, and heat-treating facilities for high-strength alloys were installed at each plant. In addition, an entirely new rolling mill was constructed which is reputed to be the largest in the British Isles.

Bauxite production from County Antrim in Northern Ireland in 1944 dropped to less than half of the 1943 total, owing to the aluminum cut-back in the British Isles. Supplementing this source of supply, ores were imported from Gold Coast and British Guiana in 1944.

U. S. S. R.—Russian reports indicate that a new aluminum-reduction plant and a Bayer-process alumina plant are under construction in the northern Urals near the Krasnaya Shapochka bauxite deposits at Bogoslovsk. The alumina plant and power station are said to have been virtually completed during 1944, and first production of metallic aluminum from the reduction plant is expected early in 1945. The Kamensk aluminum plant in the Urals, which began operations in 1940, is reported to have produced $2\frac{1}{2}$ times as much alumina and aluminum in 1944 as it did before the war. Originally planned ultimate annual capacity of the plant is believed to have been approximately 50,000 tons. Pravda reported that Siberian aluminum production will be greatly increased by the completion of the new plant at Stalinsk in Kemorovo Oblast, the second section of which commenced operations in 1944. Newly discovered deposits of bauxite are reported in the western Altai Mountains in Siberia.

Venezuela.—According to The Gaceta Oficial of June 9 and 10, 1944, applications for exclusive exploratory concessions in an area of 50,000 hectares in the Department of Antonio Diaz in the Federal Territory of the Delta Amacuro, believed to contain bauxite deposits, have been made in the name of Republic Mining & Manufacturing Co., a subsidiary of Aluminum Co. of America.

MERCURY

By HELENA M. MEYER AND ALETHEA W. MITCHELL

SUMMARY OUTLINE

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SUMMARY

The development in 1944 of a new dry-cell battery, an important component of which is mercuric oxide, resulted in requirements for mercury so large as to reverse completely the outlook for the mercury industry. This battery is described under "Consumption and Uses."

The world mercury industry is a small-quantity business. The sources of supply are relatively concentrated, and usually they are largely cartel-controlled. Price does not enter into the determination as to whether or not the metal will be used in most instances. For many uses the efficiency of mercury leads to its continued demand even when supplies are difficult to obtain. The mercury industry is volatile from an economic viewpoint largely because of the conditions outlined, and its history during the war period bears out this assertion. In the United States mercury was the first strategic metal to complete the cycle from scarcity to plenty. The prospective gains in demand in the United States and the expected divorce of the United States from its usual sources of supply, because of shipping difficulties, led to the near tripling of the domestic prewar price by June 1940. The next 3 years witnessed sharp increases in production in the United States and its neighbors, Canada and Mexico, consumption restriction, price control, and Government-purchase contracts. War planning for the mercury industry was more than well done, with the result that by the end of 1943 the market faced near-record supplies, a rapidly diminishing consumption, and a declining price structure supported only by Government-purchase contracts.

At the outset of 1944 the outlook for the domestic mercury producer was gloomy. Government purchases were discontinued in January, the Government submitting to the requirement for making certain penalty payments for contract cancellations, as described in the chapter on mercury, Minerals Yearbook 1943. Production dropped notably in February and continued downward, almost without interruption, until the low point of 2,300 flasks was reached in

November, the lowest monthly rate since February 1940. Consumption amounted to less than domestic production beginning September 1943 and continued below it until June 1944. During this period the Consumption Restriction Order M-78, eased in September 1943, was rescinded (in February 1944). In July mercury was removed from the list of materials that were subject to the restrictions of General Import Order M-63. Beginning in August the effects of the demand for mercury for the manufacture of the new dry-cell batteries began to be felt, and consumption rose to 3,900 flasks, at which rate it continued for the remainder of the year. The explanation for the lagging rate of gain is twofold, i. e., the battery use rose in the final quarter of the year, whereas other uses declined, leaving the total unchanged, and some difficulties that were involved in battery manufacture interfered with the expected degree of the advance.

In the second half of 1944 consumption amounted to almost 1½ times as much as production. Imports during 1944 amounted to only 41 percent of those for 1943, and only 40 percent of the reduced tonnage entered the country during the latter half of the year. The Metals Reserve Company contract with the larger Canadian producer, the Consolidated Mining & Smelting Co. of Canada, Ltd., had been canceled in September 1943 and shipments against Mexican contracts, scheduled to be completed in July 1944, were permitted to be made subsequent to July with the total quantity involved unchanged. The contract with Bralorne Mines, Ltd., Canada, was canceled in September. In the late months of 1944, therefore, the importation of mercury had been largely restored to private hands.

Salient statistics of the mercury industry in the United States, 1940-44

[Flasks of 76 pounds]

	1940	1941	1942	1943	1944
Production..... flasks..	37,777	44,921	50,846	51,929	37,688
Number of producing mines.....	159	197	184	146	102
Average price per flask:					
New York.....	\$176.87	\$185.02	\$196.35	\$195.21	\$118.36
London.....	\$201.10	\$194.20	\$227.87	\$281.44	\$281.44
Imports for consumption:					
Pounds.....	12,971	588,228	2,959,489	3,633,216	1,486,025
Equivalent flasks.....	171	7,740	38,941	47,805	19,553
Exports:					
Pounds.....	730,877	196,837	26,252	29,236	56,755
Equivalent flasks.....	9,617	2,590	345	384	747
Consumption..... flasks..	26,800	44,800	49,700	54,500	42,900

¹ Large amounts were reexported in 1942 and 1943 (see section on Foreign Trade).

The low point in prices was reached in July, when the monthly average amounted to less than \$101 a flask, or to little more than half the annual averages for 1942 and 1943. The sharp reductions in supplies of mercury in the United States from domestic and foreign sources, coupled with the upturn in consumption, beginning in August, and with the anticipation of considerably greater gains throughout 1945, were responsible for growing concern on the part of consumers regarding their ability to obtain enough metal to fill their needs. As requirements outstripped demand, the price advanced. It averaged \$129 a flask in December, and the uptrend was far from halted at that point. By the end of November, industry stocks were at their lowest

levels since the Bureau of Mines monthly canvass began in September 1939 and for an indeterminate period before that, and spot metal was difficult or impossible to obtain. The War Production Board took cognizance of the growing seriousness of the situation by announcing on December 1 that the Metals Reserve Company, at the recommendation of the War Production Board, would release mercury from the Government stock pile for filling current war and essential civilian needs.

Thus, unforeseen developments reversed the conditions of oversupply in the mercury industry during the year. The same statement may be made concerning numerous other commodities, but, as in creating sufficient supplies first, mercury again was ahead of most others. Its unbalance came before the set-back, in the fall, to Allied hopes for an early end to the European phase of the war.

Metals Reserve Company's domestic purchases.—The discontinuance of domestic purchases by the Metals Reserve Company at the end of January 1944 and the penalties involved thereby were described in the report of this series for 1943.

General Import Order M-63.—Imports of mercury were subject to the limitations of M-63 beginning December 28, 1941. In July 1944, when supplies of mercury appeared to be ample for all emergencies and when the problem appeared to be more one of surplus than of deficiency, mercury was removed from the list of products that were under control of the import order.

Surplus Property Act.—The passage of the Surplus Property Act, effective October 3, relieved anxiety regarding surpluses that were expected to be on hand at the end of the war. The act provided that all Government-owned accumulations of certain strategic minerals and metals, of which mercury was one, when determined to be surplus, should be added to the permanent Government stock pile authorized by the act of June 7, 1939.

Releases of mercury from Metals Reserve Company stock pile.—The situation created by the rapid increase in demand for mercury due to the production of a new mercury battery has been described already. The War Production Board moved to remedy a critical supply situation by announcing, on December 1, that the Metals Reserve Company, upon recommendation of the War Production Board, would release mercury from the stock pile for current war and essential civilian needs. The metal was released at \$2 a flask above the quotation in Metal and Mineral Markets on the Thursday subsequent to the execution of the contract.

The indications are that there was a sharp reduction also in world production outside of the United States. Western Hemisphere sources were affected by expanding supplies in the United States at the beginning of 1944, which led to the cancellation of Metals Reserve Company's contracts or their failure of renewal; Chile's contract, however, ran shortly beyond the end of the year. Canadian production dropped 57 percent and Mexican 7. Precise data for Spain and Italy are not available, but output in the former was reported to be at a greatly reduced rate because of large stocks, and that in the latter was affected adversely by the fighting that took place in the most productive area.

Geological Survey and Bureau of Mines activities.—The Geological Survey had completed most of the necessary field work in its study

of all major quicksilver deposits in the United States by the end of 1944. Field work now in progress consists of areal mapping in the New Almaden quicksilver district, Santa Clara County, Calif.; completion of studies of the Oregon deposits; and a detailed study of the deposits at Steamboat Springs, Nev. Field work on the Terlingua district, Texas, and Oat Hill mine, Lake County, Calif., has been completed, and reports on these districts are in the process of preparation.

The California Division of Mines expects to publish a comprehensive bulletin on quicksilver deposits of California, using reports by the Geological Survey on the following districts: Panoche, Knoxville, East and West Mayacmas, New Idria, Guerneville, Cachuma, and Sulphur Bank. The report published by the Nevada State Bureau of Mines on quicksilver deposits in Nevada is now available.¹

Announced by press releases were the availability of maps and brief text descriptions of the Harry Area, New Almaden mine, Santa Clara County, Calif.; 248 mine, Terlingua district, Texas; Mariposa mine, Terlingua district, Texas.

The Geological Survey continued investigations of Alaskan quicksilver deposits during 1944. Deposits near the abandoned village of Kolmakof in the central Kuskokwim region were examined in detail in conjunction with trenching operations by the Bureau of Mines. The basins of the Wloyukuk and Oskawalit Rivers were explored, and formations favorable for the occurrence of quicksilver were discovered along the latter stream.

Field work on the study of mercury resources of Mexico was completed by the Geological Survey under the auspices of the State Department, and two reports resulting from these studies are in process of publication. A study of the mercury resources of Chile was made, and the results of this investigation also are in the process of publication.

The work of the Bureau of Mines in the exploration of mercury deposits and the results obtained up to June 30, 1944, were summarized by Mosier.²

The results included a total of 40,307 feet of drilling, 33,082 linear feet of surface trenching, with ore reserves indicated as 389,600 tons of commercial ore containing an average of 7.4 pounds of mercury per ton and 1,008,000 tons of marginal ore containing 2.2 pounds per ton. The report states that the equivalent mercury in the reserves indicated was 37,400 and 29,200 flasks, respectively, or a total of 66,600 flasks. As of June 30, the Bureau had examined 190 deposits, as follows: Alaska, 3; Arizona, 9; Arkansas, 31; California, 38; Colorado, 2; Idaho, 16; Michigan, 1; Nevada, 43; New Mexico, 1; Oregon, 27; South Dakota, 1; Texas, 11; Utah, 2; Washington, 3; and West Virginia and Wyoming, 1 each. Fifteen exploratory projects were started after these examinations, and 13 had been completed by June 30.

War Minerals Reports were prepared for limited distribution on the following properties in 1944: Alice and Bessie mine, Sleitmut area, Alaska; Decoursey Mountain Mercury deposit, Iditarod district, Alaska; mercury deposits, Pike County, Ark.; New Idria mine, San

¹ Bailey, E. H., and Phoenix, D. A., *Quicksilver Deposits in Nevada*: Univ. of Nev. Bull., vol. 38, No. 5, December 1944, *Geology and Mining Series* No. 41, 206 pp.

² Mosier, McHenry, *Bureau of Mines Exploration of Mercury Deposits to June 30, 1944*: Bureau of Mines Inf. Circ. 7299, November 1944, 14 pp.

Benito County, and New Almaden mine, Santa Clara County (supplement to report completed May 1943), Calif.; and Terlingua mercury district, Brewster County, Tex. (supplement to report made in December 1942).

POSTWAR OUTLOOK

Developments in 1944 have caused a marked change in the outlook for mercury. The question as to what place the new dry-cell battery, which employs mercury, will have in the future is so important that its answer should indicate whether or not postwar consumption levels will be similar to or higher than they were in the prewar period. Beginning in 1945, for example, the war needs for the new battery are expected to take much more mercury than all other uses combined. The battery's proponents anticipate that it will have large industrial application after the war, and some of the suggested uses are hearing aids, fire-alarm equipment, and portable radio sets. Considerable research probably will be required before the battery can be assured of a substantial market, and the pressure for speed in supplying war demands has interfered with carrying on adequate research work. Other uses for mercury are expected to follow the pattern outlined briefly in the chapter of this series for 1943. How much of the total postwar consumption, which should be at prewar or higher levels, will be supplied by domestic mines will depend largely on price, and the price will be determined, in part, by the Government's attitude on the continuation of the tariff on mercury. With a large postwar demand and the protection of the tariff of \$19 per flask, it is probable that most of the present larger domestic producers would aid in supplying requirements for mercury after the war. A sharp decline in prices, such as followed World War I, however, would close all but a very few domestic mines. A low postwar price would return the task of supplying world mercury needs largely to Spain and Italy.

PRICES

Prices for mercury in 1944 clearly mirrored the rapidly changing conditions of supply in this industry. The average quoted price had remained at the level of \$196 a flask (76 pounds) in New York from the last week in October 1942 to the last week in September 1943. Easing conditions of supply at the end of that period brought with it a declining price. By the end of the year, the quotation had dropped to a range of \$190 to \$193, but much of the production at that time and during January was being purchased by the Metals Reserve Company. As has been indicated in this report, purchases of the Metals Reserve Company ceased at the end of January. In January 1944 the monthly average was \$152, but the price range at the month end was \$130 to \$140. The downtrend continued until a monthly average of \$101 was established in July. The July average was only half that for January 1942, the last month before the Government established ceiling-price limitations. The revised supply-requirements situation in the fall of 1944, described in the opening section of this report, caused an upturn in prices that continued beyond the end of the year. In December the monthly average was \$129 a flask, but at the end of the month the quotation was \$140 to \$145, and the trend continued upward another month until offerings of Spanish mercury in New York for future delivery dampened the ardor of purchasers.

Average monthly prices per flask (76 pounds) of mercury at New York and London, and excess of London price over New York price, 1942-44

Month	1942			1943			1944		
	New York ¹	London ²	Excess of London over New York	New York ¹	London ²	Excess of London over New York	New York ¹	London ²	Excess of London over New York
January.....	\$202.52	\$194.69	\$7.83	\$196.00	\$281.44	\$85.44	\$151.60	\$281.44	\$129.84
February.....	197.27	194.69	2.58	196.00	281.44	85.44	130.00	281.44	151.44
March.....	197.05	194.68	2.37	196.00	281.44	85.44	130.00	281.44	151.44
April.....	197.10	194.69	2.41	196.00	281.44	85.44	128.20	281.44	153.24
May.....	197.30	194.69	2.61	196.00	281.44	85.44	115.54	281.44	165.90
June.....	194.28	194.69	.41	196.00	281.44	85.44	101.69	281.44	179.75
July.....	194.43	194.69	.26	196.00	281.44	85.44	100.56	281.44	180.88
August.....	194.43	257.56	63.13	196.00	281.44	85.44	104.04	281.44	177.40
September.....	194.43	278.52	84.09	195.72	281.44	85.72	104.28	281.44	177.16
October.....	195.35	278.52	83.17	195.00	281.44	86.44	109.20	281.44	172.24
November.....	196.00	278.52	82.52	193.70	281.44	87.74	116.30	281.44	165.14
December.....	196.00	278.52	82.52	190.08	281.44	91.36	128.88	281.44	152.56
Average.....	196.35	227.87	31.52	195.21	281.44	86.23	118.36	281.44	163.08

¹ Engineering and Mining Journal, New York.

² Mining Journal (London) prices in terms of pounds sterling are converted to American money by using average rates of exchange recorded by Federal Reserve Board. Official prices, established early in May 1941, were £47 15s. to £48 15s. per flask until August 1942, when they were raised to £68 10s. to £69 15s.

³ New York excess.

Control maximum prices in London remained unchanged from those during the late months of 1942, at £69 15s. a flask for over 1 flask and less than 11 flasks and £69 for larger amounts, ex-sellers' premises in both cases. Higher prices prevailed for lots under 1 flask and for redistilled grades.

CONSUMPTION AND USES

Consumption and uses of mercury were outlined broadly in the report of this series for 1943. Since that report was prepared, an outstanding change has taken place, the potentialities of which cannot be gaged as yet. The successful production of the new dry-cell battery previously mentioned was begun in 1944, and the use of mercuric oxide as a principal ingredient has had a profound effect upon the outlook for mercury. The new battery cell is encased in a steel can, which is used as the positive pole in creating an electric current. Mercuric oxide and layers of zinc and paper, especially prepared, are arranged to fit into the container in a spiral, like a "jelly roll." A zinc pellet at the top of the can, but insulated from the steel, serves as the negative pole. The chief value of the cell is said to be its ability to stand up under high temperatures and high humidity. Other features of the battery are its long shelf life, its ability within its rated current range to deliver the same ampere-hours service whether operated intermittently or continuously, and its much greater power for the size of unit used. This battery was developed by P. R. Mallory & Co., Inc., which controls the patents for its use.

Consumption of mercury for the new battery in 1945 is expected to exceed that used for all other purposes combined. These heavy war demands have interfered with carrying on adequate research into the postwar possibilities for the battery, as indicated in the company's statement to stockholders, dated February 5, 1945, as follows:

It is still too early to hazard any fair appraisal of the peacetime significance of this development. At the moment, all effort is concentrated on increased production to meet expanding military requirements.

Supply of mercury in the United States, 1940-44, in flasks of 76 pounds

Year	Production	Imports for consumption	Exports	Consumption
1940.....	37,777	171	9,617	26,800
1941.....	44,921	7,740	2,590	44,800
1942.....	50,846	¹ 38,941	¹ 345	49,700
1943.....	51,929	¹ 47,805	¹ 384	54,600
1944.....	37,688	19,553	747	42,900

¹ Large amounts were reexported in 1942 and 1943 (see section on Foreign Trade).

Mercury consumed in the United States, 1943-44, in flasks of 76 pounds

Use	1943 ¹	1944 ¹	Use	1943 ¹	1944 ¹
Pharmaceuticals.....	14,563	8,358	Electrical apparatus.....	3,284	7,092
Dental preparations.....	556	442	Industrial and control instruments.....	² 3,674	² 3,249
Fulminate:			Amalgamation.....	24	29
Munitions.....	1,931	1,890	General laboratory.....	360	265
Blasting caps.....	1,211		Vermillion.....	185	323
Munitions other than fulminate.....	1,286		Redistilled.....	² 5,384	² 6,613
Agriculture.....	² 1,993	3,930	Other.....	² 10,880	1,913
Anticoagulating paint.....	2,702	2,439			
As a catalyst or in the electrolytic preparation of—					
Chlorine.....	691	657		54,500	42,900
Caustic soda.....					
Acetic acid.....	1,995	1,981			
Other.....	2,437	2,783			

¹ The items are on a partial-coverage basis and do not add to the total, which has been increased to cover approximate total consumption.

² Revised.

³ About half of the quantity shown under "Redistilled" was for use in industrial and control instruments.

⁴ A large part of the total was for chemical-warfare purposes.

STOCKS

Consumers and dealers held 10,400 flasks of mercury at the end of 1944, compared with 13,200 at the beginning of the year, or a decrease of 21 percent. Companies that account for more than 95 percent of the total production held 2,714 flasks at the end of 1944, compared with 3,457 at its beginning. It should be borne in mind that the inventory data of the Bureau of Mines are on a physical rather than an ownership basis. Total industrial stocks gained in December. At the end of November, however, when they aggregated 9,900 flasks, they were the smallest on record since the Bureau of Mines inaugurated monthly surveys on mercury, in September 1939, and probably for a substantially longer period. At the end of 1944, some mercury that had been sold under the recent order for releasing metal from the stock pile was still held by the Metals Reserve Company, but it was not counted as part of their inventory. Inasmuch as industry stocks are on a physical basis, an unmeasured amount of mercury was not accounted for at all in the total year-end inventory.

REVIEW BY STATES

As was pointed out in the opening section of this report, the outlook for the domestic producer was gloomy at the outset of 1944. In

October 1943 the War Production Board announced that its aim was to reduce domestic production and imports in 1944 each to 70 percent of the 1943 quantities. Purchases of the Metals Reserve Company were to cease at the end of January 1944, and prices were already declining rapidly. It is merely a coincidence, however, that production of mercury in 1944 came so close to the proposed reduction of the War Production Board, or to 73 percent of the 1943 total, because after midyear 1944 the demand for mercury increased and prices headed upward, beginning in July. Production totaled 4,400 flasks in January when producers were trying to build up as high a production rate as possible, against which Metals Reserve Company contract-cancellation penalty payments would be made. After the outlook improved and prices rose, there was relatively little change in the rate of production, as shown in the table that follows. Perhaps the plunge in prices from late 1943 to July 1944 was too fresh in producers' minds.

Mercury produced in the United States, 1940-44, by months, in flasks

Month	1940	1941	1942	1943	1944
January.....	1,800	3,100	3,700	4,200	4,400
February.....	2,200	2,900	3,400	3,900	3,800
March.....	2,500	3,500	4,100	4,600	3,800
April.....	2,700	3,500	4,200	4,600	3,700
May.....	3,100	3,600	4,800	4,200	3,400
June.....	3,000	4,000	4,900	4,100	3,000
July.....	3,200	3,400	4,700	4,300	2,700
August.....	3,500	4,100	4,500	4,500	2,500
September.....	3,600	4,200	4,200	4,500	2,500
October.....	3,600	4,000	4,100	5,200	2,700
November.....	3,400	3,800	4,100	5,000	2,300
December.....	3,700	3,900	4,400	4,200	2,500
	1 37,777	1 44,921	1 50,846	1 51,929	1 37,688

¹ Final annual figure; monthly totals not adjusted.

Mercury produced in the United States, 1941-44, by States

Year and State	Pro- duc- ing mines	Flasks of 76 pounds	Value ¹	Year and State	Pro- duc- ing mines	Flasks of 76 pounds	Value ¹
1941:				1943:			
Arizona.....	5	873	\$161,522	Alaska.....	3	786	\$153,435
Arkansas.....	19	2,012	372,280	Arkansas.....	3	641	105,809
California.....	87	25,714	4,757,604	California.....	18	1,532	299,082
Nevada.....	64	4,238	784,115	California.....	65	33,812	6,600,440
Oregon.....	21	9,032	1,671,101	Idaho.....	1	4,261	831,790
Utah.....	1	19	3,515	Nevada.....	33	4,577	893,478
Alaska, Idaho, Tex- as, and Washing- ton.....	10	3,033	561,166	Oregon.....	16	4,651	907,922
	197	44,921	8,311,283	Texas.....	7	1,769	345,326
					146	51,929	10,137,060
1942:				1944:			
Arizona.....	7	701	137,641	Arizona.....	3	648	64,861
Arkansas.....	16	2,392	469,669	Arkansas.....	8	191	22,607
California.....	85	29,906	5,872,043	California.....	68	28,052	3,320,235
Nevada.....	40	5,201	1,021,217	Nevada.....	17	2,460	291,166
Oregon.....	23	6,935	1,361,687	Oregon.....	8	3,159	373,899
Alaska, Idaho, Tex- as, Utah, and Washington.....	13	5,711	1,121,355	Texas.....	4	1,065	129,604
	184	50,846	9,963,612	Alaska and Idaho...	4	2,183	258,390
					102	37,688	4,460,753

¹ Value calculated at average price at New York.

The 27-percent drop in production for the country was not shared in equally by the contributing States. Production in California, for example, declined only 17 percent. Arkansas, on the other hand, experienced a drop of 88 percent. Idaho, where the country's second largest 1943 producer was idle for several months, had the next most severe drop; Nevada fell 46 percent; Texas, 38 percent; and Oregon, 32 percent.

The principal producing mines in 1944 were as follows:

Alaska—Red Devil and Decoursey Mountain mines.

Arizona—Gila County, Ord mine; Maricopa County, Pine Mountain mine.

California—Contra Costa County, Mount Diablo mine; Lake County, Abbott, Mirabel, Sulphur Bank and Helen mines; Napa County, Oat Hill and Knoxville mines; San Benito County, New Idria mine; San Luis Obispo County, Klau and Buena Vista (Mahoney) mines; Santa Barbara County, Falcon (Santa Ynez) mine; Santa Clara County, New Almaden and Guadalupe mines; Sonoma County, Mount Jackson and Culver-Baer mines; Trinity County, Altoona mine; Yolo County, Reed mine.

Idaho—Valley County, Hermes mine.

Nevada—Esmeralda County, Red Rock mine; Humboldt County, Cordero mine; Pershing County, Pershing and Red Bird mines.

Oregon—Douglas County, Bonanza mine; Jefferson County, Horse Heaven mine.

Texas—Brewster County, Chisos-Waldron, Big Bend, and Texas Almaden mines; Presidio County, Fresno mine.

These 31 mines in 1944 produced 97 percent of the United States total; in 1943, 28 mines contributed 90 percent, and in 1942 it took 34 mines to produce 89 percent.

Of the larger mines in 1943, the Humphreys and United States Mercury Co. properties in Arkansas, the Socrates in California, and the Silver Cloud in Nevada were dropped from the list, whereas the following found places thereon: Decoursey Mountain in Alaska, Pine Mountain in Arizona, Helen, Culver-Baer and Altoona in California, Red Rock in Nevada and the Chisos-Waldron in Texas. Approximately half of the principal mines listed for 1944 were idle in December, most of which appeared to have no immediate plans for reopening.

As a consequence of lower prices in 1944 the average recovered grade of ore treated rose. It was 0.47 percent (9.4-pound ore) in 1944, compared with 0.31 percent (6.28-pound ore) in 1943 and 0.25 (5-pound ore) in 1942. The 1944 average was the highest on record since 1926, when the recovered grade was 0.54 percent (10.8-pound ore). The grade was raised in 1944 by the closing of many low-grade properties and by the mining of higher-grade areas in properties that remained in operation.

Alaska.—Mercury was produced in 1944, as in 1943, in the Sleitmut and Decoursey Mountain areas, the 1944 output exceeding that for 1943. All metal from both the Red Devil (New Idria-Alaska) and the Decoursey Mountain properties went to Metals Reserve Company depots, and both properties closed when contracts with that organization were completed. The furnace at the Red Devil mine was closed on April 10, after which production from clean-up operations was continued by retort into June. Decoursey Mountain also closed in June.

Arizona.—Productive operations were carried on at three Arizona properties in 1944: The Ord mine in the Brown district, Gila County, and the Pine Mountain and National mines in the Sunflower district, Maricopa County. Furnaces were used at all three locations, and a

retort for higher grade ore also was used at the Ord mine. The 60-foot Gould rotary furnace at the National mine was installed in 1943, and a new Cottrell rotary was reported erected there in 1944.

Arkansas.—The mercury industry in Arkansas came to a virtual standstill in 1944. After producing over 1,100 flasks a year for 4 years and well over double that amount in 1942, output dropped to only 191 flasks in 1944. The Humphreys mine in Clark County made a relatively large production in 1943. It was the largest producer again in 1944, with an output of 72 flasks, despite the fact that it closed on February 20. Other producers in Arkansas in 1944, all in Pike County, were the property of the Arkansas Quicksilver Mines, Inc., Muddy Fork, Hintze, Wall Mountain, and three smaller contributors.

California.—Production of mercury in California was bolstered by the continued high rate of production at the New Idria mine and by the gains of 92 percent in output for the Reed and 93 percent for the Abbott. As a consequence, the output for the State amounted to 28,052 flasks, compared with 33,812 in 1943, or a decline of only 17 percent, compared with a loss of 27 percent for the country as a whole. Important 1943 producers that showed noteworthy losses in 1944 include the Mount Diablo, Sulphur Bank, Oat Hill, Klau, and Falcon mines.

Sixteen counties contributed some production in 1944, as follows: Contra Costa, Del Norte, Fresno, Inyo, Lake, Mono, Monterey, Napa, San Benito, San Luis Obispo, Santa Barbara, Santa Clara, Sonoma, Stanislaus, Trinity, and Yolo.

The Mount Diablo mine in Contra Costa County was a producer of substantial amounts of mercury in the first half of 1944, but production was suspended in August.

A small production was made in a 2-ton inclined retort at the Patricks Creek mine, Del Norte County. A small contribution also was made by a property in Fresno County.

In the first half of 1944, production was reported for the King (Coso) and Atlas mines, Inyo County. No production is believed to have been made from June until the end of the year.

Lake County was second only to San Benito as a mercury-producing area in the United States. Its output totaled 3,776 flasks, which were recovered from 17,770 tons of ore. The Abbott mine was the most important producer in the county with a production gain of 93 percent over 1943. It ranked third in the country compared with ninth in 1943, which position was a substantial improvement over the year before. The Mirabel, Sulphur Bank, and Helen mines ranked next in order, and each produced more than 100 flasks. Other producing mines in the county were the Bullion (Otto), Great Western, and Thorne. All of the ore was treated in furnaces except that from the Thorne, which was treated in a retort.

Development by diamond drilling was reported at the Occidental mine, Mendocino County, where the furnace was undergoing repairs.

The Paramount mine, Mono County, produced a small amount of mercury in 1944, but closed in January owing to the discontinuance of the Metals Reserve Company's purchase program. Production was made in a furnace that was reported to have been removed from the property in the latter half of the year.

The output of 1,203 flasks of mercury in Napa County in 1944, of which 1,167 flasks were from the treatment of 23,990 tons of ore,

made this the sixth-ranking county in the State. Production was chiefly from the Oat Hill and Knoxville mines. At the Oat Hill mine 13,280 tons of ore were treated in a 4-by 60-foot rotary furnace, and 588 flasks of mercury were recovered. The company reported that operations were suspended on July 1 and the equipment was being dismantled. Gamble & Wilson treated 7,712 tons of ore in a 3-by 40-foot rotary furnace at the Knoxville mine and produced 463 flasks of mercury. Operations there were closed September 30. Subsequently a small output was reported to have been made by another operator. Other producers in 1944 were the Oat Hill Extension, Eureka No. 3 dump, Manhattan, James Creek placer, Aetna, and Corona properties.

San Benito County was the most important mercury-producing county in the United States in 1944. This preeminent position was due, of course, to the output of the New Idria mine, which produced more mercury than the next four largest producers in the country. The closing of the Consolidated property in British Columbia caused New Idria to be the largest producer in the Western Hemisphere also. San Benito County produced 12,374 flasks in 1944, compared with 14,187 in 1943. Except for the New Idria mine, there was no large producer in the county. Production was reported for the Lea-Grant, Stayton, and eight smaller operations. A recent court decision³ determined in New Idria's favor the contention that percentage depletion be computed on the gross sales of the first marketable product and also that depletion be allowed on material mined from old dumps.

There was a sharp drop in production of mercury in San Luis Obispo County in 1944, when 943 flasks were produced, compared with 2,618 flasks in 1943. The termination in April of mining operations at the Klau mine, the largest producer since 1939, was the chief reason for the poorer showing. The company reported that lower prices and the shortage of labor, which impeded development, were the causes of the cessation of operations. The plants were said to be largely dismantled. A total of 4,092 tons of ore was produced and furnaced, and 453 flasks of mercury were produced before the close-down. The Buena Vista mine was the second largest producer. It was leased by E. Julian Phillips until November 4, after which it was leased by Virgil Smith, both of whom produced. Two operators also produced at the Oceanic mine. The Oceanic Mining Co., operating in the latter part of the year, reported closing October 4 because of the labor shortage. Lawrence Requa, producing at the Polar Star mine, stated that the operations were discontinued, the plant dismantled, and the property returned to the owners as of May 29. The Buckeye mine and two others complete the list of producers in the county.

Three properties in Santa Barbara County produced in 1944, the principal one being the Falcon (Santa Ynez) mine, which was productive through July. The others were the Red Rock and the Lion Den.

The New Almaden mine was again by far the largest producer in Santa Clara County. Total production for the county amounted to 1,699 flasks, compared with 1,729 flasks in 1943 and 2,283 in 1942. Shortage of labor impeded operations at the New Almaden mine, and production was reduced as compared with 1943. Operation of the recently installed Gould rotary furnace at the Guadalupe mine re-

³ *Mining Congress Journal*, vol. 30, No. 11, November 1944, pp. 21-23.

sulted in a noteworthy gain in production at this property. The furnace was recently described briefly.⁴

Production in Sonoma County in 1944 was dominated by the Mount Jackson mine, as it had been for several years. The total for the county amounted to 2,878 flasks in 1944, indicating a noteworthy decline from 4,111 in 1943 and 4,114 in 1942. The Culver-Baer ranked second in 1944. Rotary furnaces were used at the foregoing mines, and retorts were used at the other productive properties, including the Socrates (clean-up), Buckeye, Wild Hog, and Dewey Geyser Mercury Mines. The Mount Jackson mine was described recently.⁵

A small amount of mercury was recovered from clean-up operations at the Adobe mine, Stanislaus County.

In 1944 the Altoona mine, Trinity County, ranked as the ninth largest mercury-producing mine in the United States. Its output was several times that for the year before. Operations were suspended November 15 for the winter season. There was no other producer in the county.

The second largest mercury producer in the United States in 1944 was the Reed mine, Yolo County, the only active mercury property in the county. It was one of the few important mercury producers in the country to increase its output in 1944, the rise amounting to 92 percent.

Idaho.—The Hermes mine, Yellow Pine district, Valley County, was the only mercury producer in Idaho in 1943, when it ranked as the second largest producer in the country. The Hermes mine produced during every month in the first half of 1944 but closed in June. After the demand for mercury improved, production was resumed in November, but a labor shortage impeded large-scale operations. The Hermes placed seventh among the mercury-producing mines of the country in 1944 with a production of 1,332 flasks from 11,409 tons of ore. A small production of mercury was made by the Lackey mine in Washington County in 1944.

Nevada.—Output in Nevada was cut virtually in half in 1944, dropping from 4,577 to 2,460 flasks, or 46 percent. Noteworthy declines were reported by the Silver Cloud, Red Bird, and Pershing mines. The Cordero mine continued as the outstanding producer in the State and ranked sixth among producers in the United States.

The Silver Cloud mine, Ivanhoe district, Elko County, produced in January and the first days of February. The lease was subsequently canceled. A few flasks also were produced from clean-up operations at the Velvet mine in the same district.

The Red Rock mine, Oneota district, Esmeralda County, was in production during the latter part of the year only. Production amounted to 124 flasks from 415 tons of ore treated in a Gould rotary furnace.

Production of mercury in Humboldt County in 1944 was largely from the Cordero mine, which was the largest producer in Nevada and the sixth largest in the country. Production is made in a 125-ton Herreshoff furnace. Rehabilitation of old works and development of new ore bodies were reported to be the chief activities at the Cahill mine, which produced 32 flasks during the year. The Blackrock mine

⁴ Engineering and Mining Journal, Guadalupe Mercury Mine Has New Treatment Plant: Vol. 45, No. 6, June 1944, p. 86.

⁵ Mining World, vol. 6, No. 6, June 1944, p. 45.

also produced, but it closed in the spring of 1944. Construction of a new plant and development were reported at the Blue Bucket mine in 1944, but there was no production.

Four operators produced small amounts of mercury in Mineral and Nye Counties in 1944.

Pershing County was the source of 685 flasks of mercury in 1944, compared with 1,749 flasks in 1943. There were seven productive mines in 1944, compared with 11 in 1943. The largest producer in both years was the Pershing mine in the Antelope Springs district. This property ceased all operations on June 1, and plant machinery and equipment were reported sold to a machinery dealer. Other productive mines were the Red Bird, Goldbanks, Vermilion, and three smaller ones. Production of the first three properties was made in furnaces and that of the others in retorts. The Goldbanks ore was trucked over 100 miles to the Opalite mine, across the State line in Oregon, for treatment.

Oregon.—Oregon ranked second among the mercury-producing States in 1944, a position it has held continuously since 1936. Production amounted to 3,159 flasks, or a decline of 32 percent from 1943, and it was equivalent to only 35 percent of the outputs for 1940 and 1941. The Bonanza mine, Douglas County, experienced no difficulty in maintaining first place among producing properties in Oregon in 1944; in the United States it dropped to fifth from third place. Its production of 2,426 flasks in 1944 came from 15,547 tons of ore.

The high-grade Maury Mountain property and three other small producers supplied the total output of Crook County. The furnace and other equipment at the Blue Ridge mine was reported to have been sold in 1943.

As usual, in 1944 the Horse Heaven mine ranked second among the mercury-producing properties of the State. Production at this property declined in 1944, but it rose to tenth rank in the country, nonetheless, because of greater decreases at some other large mines. A fire at the mine on November 22 destroyed the furnace, power plant, and other structures.

Small production from clean-up operations was reported for the Bretz and Opalite mines, Malheur County, in 1944. Press reports indicated that a contract had been awarded late in the year for deep churn drilling at the Opalite property.

Texas.—In common with other areas, Texas production dropped notably in 1944, or to 1,095 flasks from 1,769 flasks in 1943. Again the output came from Brewster and Presidio Counties. The Fresno mine, Presidio County, ranked first in the State by a narrow margin; its production amounted to 485 flasks from 5,918 tons of ore in the first 8 months of the year during which it was productive. It closed because of the low price for the metal, and no labor was available when prices improved.

The Esperado Mining Co. operated the Chisos and Waldron mines, Brewster County, as a unit in 1944 and made the second largest contribution for the State, with an output of 481 flasks from 11,816 tons of ore and tailings. The Big Bend and Texas Almaden properties, which stood first in 1943, operated in 1944 only in January. One other property had a small output in 1944.

FOREIGN TRADE⁶

Imports of mercury for consumption in 1944 fell 59 percent from the record high rate established in 1943, or from 47,805 flasks to 19,553 flasks. This drastic drop is explained by the cancellation by the Metals Reserve Company of its contracts with most foreign producers during the year; the contract with the Consolidated Mining & Smelting Co. of Canada, Ltd., was terminated in September 1943, and that with Chile ran to January 31, 1945. As a consequence of the earlier termination of the Consolidated contract, and despite imports from Bralorne Mines, Ltd., that did not start until 1944 and ceased in September, receipts from Canada registered the largest drop, or 90 percent. Chile supplied 63 percent less mercury, Peru 52 percent less, and Mexico 42 percent less. It was pointed out in the report of this series for 1943 that imports for 1943 and 1942 give a false idea of the amounts of mercury entered for use in the United States. Imports of mercury for consumption were reported as 38,941 flasks in 1942 and as 47,805 flasks in 1943. This mercury was entered for the account of the Metals Reserve Company. Totals of 7,461 and 14,852 flasks, respectively, were reexported in 1942 and 1943. In relation to the figures for earlier years, therefore, the import totals for 1942 and 1943 are too high. From available information it is not possible to assign the totals reported to the countries of origin.

General imports, which may differ considerably from imports for consumption, have been very similar thereto during the war period. In 1944 general imports totaled 19,819 flasks and in 1943, 47,836 flasks. The 1944 total was supplied by the following countries (comparisons with 1943 given in parentheses): Canada, 1,564 (15,582); Chile, 982 (2,660); Mexico, 17,221 (29,487); and Peru, 52 (107).

The movement of antimony-mercury concentrates to this country, which yielded an average of over 1,200 flasks annually for 1940-42, inclusive, was halted in December 1942. This class of imports was not shown separately in foreign-trade statistics.

Mercury imported for consumption in the United States, 1940-44, by countries

Country	1940		1941		1942		1943		1944	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Canada.....			59,633	\$130,468	562,348	\$1,337,640	1,184,211	\$3,009,271	118,906	\$337,177
Chile.....					107,091	266,920	202,148	506,710	74,627	152,399
Hong Kong.....	3	\$6								
Italy.....	228	316								
Mexico.....	9,698	13,681	520,692	1,171,752	2,288,505	5,122,516	2,238,725	5,010,038	1,288,548	2,012,873
Nicaragua.....					1,545	3,395				
Peru.....							8,132	19,934	3,944	9,397
Spain.....	3,042	3,958	7,903	6,373						
	12,971	17,961	568,228	1,308,593	2,959,489	6,730,471	3,633,216	8,545,953	1,486,025	2,511,756

¹ 567,059 pounds were reexported in 1942 and 1,128,727 pounds in 1943. These amounts cannot be separated by countries of origin.

⁶ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

No imports of mercury compounds were recorded in 1944, and only 15 pounds of vermilion red were entered in 1943.

Exports of mercury almost doubled in 1944, but even so they did not represent an important quantity; they approximated 4 percent of total imports for the year. The total for 1944 was 747 flasks, compared with 384 in 1943. The amounts exported in 1944 (comparison with 1943 in parentheses) were as follows: Brazil, 227 (89) flasks; Australia, 110 (2) flasks; U. S. S. R., 71 (66) flasks; and the remainder to 48 others, with no other country receiving as much as 40 flasks. Distribution by continents was as follows: South America, 295 (128) flasks; Oceania, 116 (20); North and Central America, 109 (61); Europe (including U. S. S. R.), 103 (66); Asia, 79 (79); and Africa, 45 (30).

Mercury exported from the United States, 1940-44

Year	Pounds	Value	Year	Pounds	Value
1940.....	730,877	\$1,743,149	1943.....	129,236	\$88,842
1941.....	196,837	470,903	1944.....	56,755	123,746
1942.....	126,252	76,448			

1567,059 pounds were reexported in 1942 and 1,128,727 pounds in 1943. These amounts cannot be separated by countries of origin.

Mercury salts exported in 1943 and 1944 are shown in the following table:

Mercury salts exported from the United States, 1943-44, in pounds

	1943	1944		1943	1944
Mercurous chloride (calomel).....	16,950	20,823	Mercuric oxide (red and yellow)...	50,483	13,007
Mercuric chloride (corrosive sublimate).....	12,422	21,016	Mercuric sulfate.....	36	65
Mercuric fulminate.....	35,450	26,190	Mercuric sulfide.....	25	222
Mercuric nitrate.....	570	446	Other compounds.....	7,388	10,327

WORLD PRODUCTION

Satisfactory world-production totals for the past several years continue to be unavailable. There is little doubt that high record rates were established in 1941 and again in 1942 or that production declined in 1943 and again, more sharply, in 1944; the 1944 rate may have been less than two-thirds of that for 1942. The recent drastic drop is explained by reduced production in Spain because of the large stocks held there, by the moving of the battle area in Italy through the principal mercury-producing district, and by the belief that a surplus supply situation had developed in the United States, which caused reductions in Government purchases of Mexican, Canadian, and domestic mercury.

World production of mercury, 1938-44, by countries, in flasks

[Compiled by B. B. Waldbauer]

Country	1938	1939	1940	1941	1942	1943	1944
Algeria	191	(¹)	(¹)	190	220	55	(¹)
Australia: Queensland		3	(¹)	(¹)	(¹)	(¹)	(¹)
Bolivia (exports)		7	(¹)	(¹)	(¹)	51	2
Canada	10	6	2,024	7,057	13,630	22,240	9,682
Chile	44	(¹)	(¹)	1,305	2,256	2,563	(¹)
China (free)	560	4,931	3,403	6,527	4,728	3,423	2,988
Chosen	(²)	(²)	(¹)	(¹)	(¹)	(¹)	(¹)
Czechoslovakia	2,900	2,669	2,582	(¹)	(¹)	(¹)	(¹)
Germany ³	1,750	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Austria	(²)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Italy	66,748	67,154	(¹)	(¹)	(¹)	(¹)	(¹)
Japan	502	(¹)	(¹)	660	(¹)	(¹)	(¹)
Mexico	8,519	7,376	11,653	23,137	32,443	28,321	26,063
New Zealand	10			73	150	93	(¹)
Peru					145	326	153
Rumania		(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Southern Rhodesia		(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Spain	41,409	35,912	52,214	86,473	72,288	47,756	(¹)
Tunisia	270	58	149	88	(¹)	525	(¹)
Turkey	597	359	500	242	176	186	(¹)
Union of South Africa			(¹)	204	579	1,189	613
U. S. S. R.	8,700	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
United States	17,991	18,633	37,777	44,921	50,846	51,929	37,688
Total ⁴	149,900	150,000	(¹)	(¹)	(¹)	(¹)	(¹)

¹ Data not yet available.² Conjectural.³ Estimate included in total.⁴ Slovak Metallurgical Works.⁵ Exports.⁶ Production less than 1 flask.⁷ January to June, inclusive.⁸ Production figure published by Metallgesellschaft.

Canada.—The uptrend of mercury production in Canada was reversed in 1944, when total output amounted to only 9,682 flasks, compared with 22,240, the all-time peak, in 1943. The sharp decline in 1944 is explained by curtailment and discontinuance of production by the Consolidated Mining & Smelting Co. of Canada, Ltd., whose 1943 production made it the largest producer in the Western Hemisphere in that year. Its contract with the Metals Reserve Company was terminated in October 1943, and its ability to produce far exceeded the needs of the Canadian consuming industry. The mine was closed in July 1944, according to the company's annual report, because of the falling demand for mercury and the urgent need for labor at the company's Kimberly operation. The Metals Reserve Company contract with Bralorne Mine, Ltd., ran until September 1944, when that company's newly developed property closed.

In connection with the cessation of mercury production in 1944, Sargent⁷ stated that:

Interesting possibilities of future production remain, as factors other than costs influenced the suspensions, and it might be expected that production would be easier when supplies, machinery and personnel are available more readily than under war conditions.

The Pinchi Lake plant of Consolidated Mining & Smelting Co. of Canada, Ltd., was described recently.⁸

The following figures on consumption of mercury in Canada by uses were taken from the report of the Dominion Bureau of Statistics for 1943 on miscellaneous metals:

⁷ Sargent, Hartley, A Review of the Mining Industry in British Columbia: Western Miner, vol. 18, No. 4, April 1945, p. 51.

⁸ Canadian Institute of Mining and Metallurgy Bull., Pinchi Lake Mercury Reduction Plant: Vol. 48, No. 393, January 1945, pp. 13-26.

Mercury consumed in Canada, 1939-42, by industries, in pounds

	1939	1940	1941	1942
Medicinals and pharmaceuticals	20, 473	30, 246	67, 607	78, 362
Heavy chemicals (catalyst)	58, 954	30, 904	35, 319	50, 968
Electrical apparatus	2, 161	1, 899	25, 738	42, 313
Nonferrous smelters	857	1, 636	4, 635	1, 201
Petroleum refineries	359	328	920	684
Gold mines	6, 313	6, 000	11, 091	10, 000
Ammunition		4, 630	8, 217	-----
Other industries	500	-----	2, 591	1, 650
Total accounted for	89, 617	75, 643	156, 118	185, 178

Italy.—Italy surrendered to the Allies in 1943, but the delayed expulsion of the German Army from the section north of Rome denied the benefits of Italian mercury to the Allies during much of 1944. The principal Italian production in recent years has come from the Monte Amiata district, about 75 miles north of Rome, Siena and Grosseto Provinces, where the chief mines are the Abbazia San Salvatore and the Solforate del Siele. When the Germans withdrew from the Monte Amiata district in 1944, only the Abbazia was seriously damaged. The surface plant was completely destroyed, but the main hoist and much portable equipment were saved. Since liberation, some of the furnaces have been rebuilt and put into operation beginning in September. Operations in the district were handicapped mainly by a severe shortage of power, minimum operations only being possible at Abbazia, pumping and partial maintenance at Siele, and nothing at all at Argus, which buys all of its power. The Argus mine was not molested by the Germans, but it sustained damage to both plant and shaft through other means. The Cerreto Piano mine, also in the Monte Amiata district and associated through ownership with the Siele, was not damaged, but it lacks power for either production or maintenance operations. Under the power conditions that prevailed early in 1945, Abbazia can produce 1,200 flasks a month. The output of the district can be expanded readily to 3,400 flasks if additional power can be made available. The Idria mine, while in German hands, was flooded and otherwise sabotaged by the Yugoslav Partisans early in 1944.

In the event that postwar world requirements for mercury are expanded above the prewar level, Italy can increase previous production rates substantially by installing additional furnace capacity. The mineralized area of the Monte Amiata district is large, and previous requirements have been insufficient to make it worth while to search for and develop new mines. The principal mines occupy a north-south belt about 20 miles long and 5 miles wide, but one active mine, the Cerreto Piano, is 20 miles southwest of this belt, and several inactive mines and prospects are well outside of the main zone. The entire district is more than 500 square miles in area. There is difference of opinion concerning reserves in the Idria deposit, which are variously reported as substantial though declining in quantity and grade and as relatively near exhaustion.

Mexico.—David Gallagher, of the United States Geological Survey, who has been in Mexico during the past 3 years, delivered a paper on the geology of the principal mercury mines of Mexico before a meeting of the United States Section of the Pan American Institute of Mining

Engineering and Geology, February 28, 1945. He observed that small operators, known as "gambusinos," had multiplied rapidly under the stimulus of high prices beginning in 1940, and that for 1940-42 their production furnished about one-half of the national total. Their crude methods, small capital, and lack of technical knowledge, however, resulted in a high rate of failure, and by 1943 most of the mercury produced was coming from larger mines in six major producing districts. The largest single producer in each of three of them was still active in early 1945.

Cinnabar is widely distributed in Mexico, he said, and is reported to occur in over 200 localities scattered throughout two-thirds of the States of Mexico. The following descriptions are quoted from his paper:

In a broad way the mercury deposits of Mexico can be divided into two major geologic classes: (1) Deposits in rhyolitic volcanic rocks, and (2) deposits in other rocks, mostly sedimentary rocks. The deposits in rhyolite are most numerous, but they are comparatively small, and very similar. In contrast, the deposits in sedimentary rocks are all different, and though few in number they include most of the large mines.

The six major districts are Huitzucó, Huahuaxtla, Nuevo Mercurio, Cuarenta, San Alto, and Canoas.

Huitzucó district.—The Huitzucó deposit, mapped by James F. McAllister of the U. S. Geological Survey, is situated in Guerrero, one of the southernmost States in Mexico. It was discovered in 1869, and had yielded a total of about 72,000 flasks of mercury and a large amount of antimony before being closed down early in 1944. It is famous as the only known large deposit of livingstonite, a rare mercury-antimony sulfide. The deposit is in limestones that were mildly folded, but much faulted and brecciated. After the limestone had been deformed it was invaded by biotite granite, and extensively replaced by dolomite and anhydrite. Later, some gypsum was formed by weathering, and deep solution holes were formed, which were filled by terrace alluvium that covered the region. Livingstonite and stibnite were deposited in the anhydritized limestone and in the gravel fill in the solution cavities. All the cinnabar is believed to be secondary after livingstonite. In the largest mine, called La Cruz, ore was mined to a depth of 770 feet, and diamond drill holes showed that it went deeper. The main stope, perhaps the largest in any mercury mine in North America, measures 360 feet long by 164 feet wide and 130 feet high. The ore was milled in a flotation plant at the mine, and the concentrates were shipped to another plant in which both the mercury and the antimony were recovered.

Huahuaxtla district.—The Huahuaxtla deposit, about 30 miles northwest of Huitzucó, was discovered in 1923. From 1941 through 1944 it has produced about 150 flasks of mercury a month. Although metacinnabar appears to be the chief ore mineral, about an equal quantity of inconspicuous, fine-grained cinnabar is present. Some carbonate, iron oxide, and a little gypsum accompany the ore.

The ore occurs in a gouge zone about 30 feet thick along a large fault which dips about 40° SW. and can be traced for several miles. Limestone forms the footwall and shale the hanging wall of the fault. The surface of the limestone in the footwall is characterized by parallel ridges 3 to 15 feet high, about 30 feet across, and 30 to 100 feet apart, that extend diagonally down the footwall surface in a westerly direction. The fault gouge consists of scattered limestone blocks in ground up shale, the blocks being largest and most abundant near the footwall.

The ore occurs in the fault gouge, and to a lesser extent in the fractured limestone adjacent to the fault. The largest ore shoots occur on the down-dip sides of the limestone ridges where the breccia is thickest, and therefore lie parallel to the ridges.

Nuevo Mercurio district.—The Nuevo Mercurio district was discovered in the desert country of northern Zacatecas, in central Mexico, in 1940. It is the most productive mercury district in Mexico, and one of the most productive in the Western Hemisphere. The monthly production has averaged 600 flasks or more, and at times has exceeded 1,000 flasks.

The Nuevo Mercurio district is in a small group of low limestone hills in a wide expanse of desert sand-flats. All water has to be brought 40 miles by rail and 15

miles by truck. The limestones and interbedded shales have been folded into many anticlines and synclines which trend N. 70° E. and are about 150 feet across. Some of the anticlines are broken by thrust faults. After the folding, two sets of approximately vertical fractures formed along which there was only small displacement. One set strikes about N. 30° W., the other about N. 10° E.

During mineralization much carbonate was deposited, and some gypsum was formed; cinnabar was deposited along many of the N. 30° W. fractures, and along thrusts following anticlinal axes. The largest and richest ore shoots were formed at the intersections of the N. 30° W. fractures with the thrusts along anticlinal axes. No ore has been found in the N. 10° E. fractures, although they contain abundant carbonate and unbroken anticlines are generally barren. Some post-ore faulting has occurred.

At Nuevo Mercurio there are 16 principal mines, about 50 smaller mines, and around 200 prospects. At one time over 900 retort tubes were in operation, but these were replaced during late 1942 and early 1943 by four 40-ton Herreschoff furnaces. Shortly afterward a 100-ton Herreschoff furnace and half a dozen 10-ton units of a newly developed furnace, called the Manfrino furnace, were added.

Cuarenta district.—The Cuarenta mercury district, discovered in 1932, is in the semi-arid mountain region of northern Durango, in central Mexico. Peak production of around 300 flasks a month was attained from 1940 to 1943. The district had produced a total of about 15,000 flasks before mining stopped in August 1943.

The oldest rock in the district is a granite that was injected, along joints, by diabase dikes and then truncated by erosion. Limestone conglomerates were deposited on the granite and later buried under a thick series of rhyolite tuffs and flows. After some minor silicification, the rocks were faulted and tilted, and cinnabar-depositing solutions rose along the faults. Where diverted and retarded by impermeable diabase dikes, faults, and silicified zones, the solutions deposited small, tabular cinnabar ore bodies, particularly near the granite—conglomerate contact. The largest ore shoots were formed at the intersections of two impermeable structural features, especially along the footwalls of the diabase dikes at their junction with the base of the conglomerate. In contrast, the few ore shoots that were localized by a single impermeable feature are small and low in grade. The ore is associated with chaledonic silica, iron oxide, and soft clay-like material.

Sain Alto district.—The Sain Alto district in western Zacatecas has produced about 200 flasks a month in recent years. The district is characterized by a highly deformed series of lower Upper Cretaceous sandstones and interbedded shales which are exposed in a piedmont area of about 40 square miles that is nearly surrounded by rhyolite mountains. The rocks are broken by numerous thrust faults and at least five sets of normal faults, most of them pre-ore. The cinnabar deposits are of two types: (1) Small deposits in the rhyolite in the mountains, and (2) desposits in the sedimentary rocks.

The cinnabar desposits in the rhyolite are widely scattered along great shear zones, some of which can be traced for miles. They are accompanied by extreme silicification and abundant iron oxide. The cinnabar is intimately mixed with a finely disseminated yellow mineral, probably a mercury chloride, that turns black in a few moments on exposure to the sun. The ore tends to occur in small rich pockets which are unattractive to large operators but which may be profitable to the local "gambusinos."

Ore has been found in the sedimentary rocks at only one place, but the principal mine there, which is 410 feet deep and still in good ore, yields more mercury than all the other mines in the district. The rocks have been broken by many faults, including numerous bedding-plane faults, accompanied by extensive drag-folding. The cinnabar occurs both disseminated in the sandstone and accompanied by carbonate in joints more or less perpendicular to the bedding. The ore-bearing zone as a whole cuts across the rocks without regard for their structure, and appears to be well defined, so that mining at deeper levels can be planned systematically. The distribution of the ore shoots within this zone, however, shows a delicate response to local structure and relative permeability of the sandstone.

Canoas district.—Cinnabar was discovered in the Canoas district, in the southeast corner of Zacatecas, in 1878. During the past few years the production has fluctuated widely but has been of the general order of 200 flasks a month. Here, a latite covered by about six feet of volcanic glass was raised into a dome which was broken at the top by several intersecting fracture zones. Cinnabar was deposited along these fractures, and the wall rocks were extensively altered. Intense silicification accompanied the mineralization and was followed by some carbonate

alteration of the wall rocks. After the mineralization the region was inundated by tremendous flows of rhyolite, that flowed against and around the pre-existing latite dome, perhaps barely overtopping it.

New Zealand.—The mercury mines of Puhipuhi are reported to be able now to supply the greater part of the requirements of Australia and New Zealand.⁹ The deposits were known and worked 20 years ago, but operations were suspended when exploratory work failed to disclose an extension of the ore body. The present expanded production began in 1941. Production is by open-cut methods, and the article describes the open cut as the deepest in New Zealand.

Spain.—The variation in 1944 production data for Spain makes it desirable to withhold figures until one or another total is confirmed. Reports indicate that 47,800 flasks were produced in 1943, compared with 72,300 flasks in 1942. Although Spain is reported to have supplied substantial amounts of mercury to Germany during World War II, and likewise to have sold substantial amounts to the Allies, stocks available for sale at the end of 1944 were reported to total 120,700 flasks, most of which was held by the Almaden operators. Owing to the large inventories, the Almaden mine was operating far below capacity at the end of the year, and it was the only productive mine in Spain. Almaden mine, of course, dominates the mercury output of Spain to such an extent that its output is always roughly indicative of the country's total. Rumors state that the mercury cartel, Mercurio Europeo, both is and is not in operation at the present time. It is rather difficult to see how it can be operating with Italian sales subject to rigid controls by the Allied Control Commission and with Spanish metal being offered in the New York market early in 1945 at prices far below the most recent cartel quotation of \$250 a flask.

Union of South Africa.—The expectation that the Monarch Kop mine, in the Murchison Range, might be able to supply not only home needs but an exportable surplus as well was realized recently. Production was reported at about 100 flasks a month in 1944. This property was brought into production under the high prices of the war, and its competitive position at postwar price levels is unknown.

⁹ Chemical Engineering and Mining Review, Mercury in New Zealand: Vol. 36, No. 432, Sept. 11, 1944, p. 339.

TIN

By C. E. NIGHMAN AND J. B. UMHAU

SUMMARY OUTLINE

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GENERAL SUMMARY

Tin's unique position among the wartime strategic and critical metals was accentuated during 1944. Whereas the supply-requirements relationships for most metals eased after Allied control of sea lanes broadened and outputs of many war goods passed their peaks, needs for tin, already the most desperate among metals, grew despite painstaking efforts of the War Production Board to limit drafts on reserve stocks. The capitulation of Germany in May 1945 and the coincident end of the European phase of the World War, if anything, put additional demands on the dwindling stocks, with little relief to be expected much before the end of 1946.

Consumption of primary tin in 1944 rose 28 percent above the 10-year low of 46,253 long tons set in 1943, owing mostly to greater tin-plate output and the continued heavy requirements for bronze and bearing alloys. Imports of metal and tin concentrates were 49,842 tons (tin content) or about one-third greater than in 1943, but the gap between supply and consumption widened, notwithstanding diversion of part of the British share of Bolivian concentrates to the United States. The tin content thereof, 7,504 long tons, was almost identical with the increase in receipts from Bolivia, which reached a total 28,584 tons in 1944. The tin content of ore and concentrate deliveries from the Belgian Congo was about 85 percent greater in 1944 than in the preceding year, and Congo pig-tin arrivals fell off about one-eighth to approximately 10,000 tons; the net result was a gain in tin supply from the Congo of approximately 11 percent or 1,900 tons. About 3,300 tons of tin that had been flown from China to India was also received. Tin plate and terneplate, as usual, were the major export items and were about 10 percent higher than in 1943 but still nearly 25 percent less than the record of 593,776 tons in 1942.

Salient statistics for tin in the United States, 1925-29 (average) and 1940-44

	1925-29 (average)	1940	1941	1942	1943	1944
Production—						
From domestic mines.....long tons.....	24	49	56.3	6.3	6	5
From domestic smelters.....do.....		1,391	1,839	16,168	21,489	30,884
From secondary sources.....do.....	30,600	29,700	37,500	33,900	33,800	29,100
Imports for consumption:						
Metal.....do.....	78,009	124,810	140,873	26,753	12,630	13,338
Ore (tin content).....do.....	175	3,000	28,670	28,933	21,857	36,504
Exports (domestic and foreign).....do.....	1,740	2,664	1,094	409	1,770	843
Monthly price of Straits tin at New York:						
Highest.....cents per pound.....	70.67	54.54	53.35	}	(1)	(1)
Lowest.....do.....	39.79	45.94	50.16			
Average.....do.....	56.64	49.82	52.01			
World production.....long tons.....	163,000	236,000	246,000	125,000	118,000	100,000

¹ Subject to revision.² Including tin content of ores used direct to make alloys.³ Figures for 1940-41 cover foreign only; domestic not separately recorded.⁴ Ceiling price, 52 cents.

Year-end stocks, in terms of tin, were 100,297 tons, distributed as follows: As pig tin, industry 19,325, Government 39,870; and in ores and concentrates awaiting treatment, 41,102 tons. Although this represents about 1½ years supply at the 1944 rate of use, only two-thirds or about 12 months supply was available as metal. The Longhorn smelter turned out over 30,000 tons in 1944 and in the forepart of 1945 was producing at a 40,000-ton rate. If that rate can be maintained and if foreign metal supply is no less than in 1944, substantial inroads on the pig-tin stocks nevertheless may be expected in 1945, especially if the use of tin is permitted in industrial reconversion during that year. In view of the needs for European rehabilitation, the indicated decline in production available to the Allies, and probable shrinkage in British stocks, the United Nations supply-demand position also probably will deteriorate in 1945.

The sales prices for Straits tin or equivalent grades were held at 52 cents a pound, unchanged from 1942 and 1943. The prices for the Government's Longhorn brands were unchanged from those set in 1942. The British price of £300 a long ton for standard tin delivered buyer's plant was effective January 1, 1944, and was not changed during the year.

POSTWAR OUTLOOK

In the chapter of this series in Minerals Yearbook, 1943, the future primary metal consumption in the United States was forecast at about the prewar level of 60,000 to 65,000 long tons annually, except for a short period when wartime-accumulated wants were being met from the first ample postwar supplies. World consumption also was expected to return to the late peacetime figure of 150,000 tons.¹

Estimates of world production from a year to 18 months after the reoccupation of Malaya, Netherlands East Indies, and Thailand and Burma have been given as 120,000 and 184,000 long tons.

Although research and development were strongly supported during the year, no substantial new use was reported. Among the more promising developments was the proposed use of speculum (about 45 percent tin and 55 percent copper) as a competitor of chrome and

¹ Tin, official bulletin of the Tin Producers' Association, in the May 1945 issue, p. 10, however, estimates "the world demand for tin will not be less than 250,000 tons a year as soon as the immediate postwar needs have been met."

nickel for plating. During the war period no substitute for tin has been reported that gives promise of large displacement of tin in post-war years.

The postwar status of the Government's Longhorn tin smelter has been the subject of considerable discussion. The principal arguments advanced for the continued existence of the smelter are: Strategic importance, as a segment of State Department (Good Neighbor) policy, and for recovery of public investment. On the other hand it has been said these arguments are not wholly valid. Military security may be secured most simply by stock-piling metal, a method already adopted in the United States. If it should again be requisite to construct a plant, it has been demonstrated that it could be accomplished in a matter of months, and the technique of ore reduction need not be lost if the smelter ceases operation. Under the concept of Inter-American mutual support it is expected that Bolivia would continue to furnish the part of its production that can be considered available for open market sale. To assure its flow to the United States would imply the payment of a premium above free market price. Since this portion is inferior in grade and highly refractory the total cost of the tin produced therefrom would be much higher than that procurable elsewhere. No matter how the difference is covered it would be a levy on the taxpayer or consumer. (See section on International Tin Control Scheme.) The investment in the Longhorn smelter is approximately \$7,000,000. Its assured operating life will exceed 5 years; usual accounting procedure would have amortized a substantial part of the investment had the smelter been a private venture instead of an emergency undertaking, the total cost of which can be considered properly a war expense. Even if salvage value is neglected, the added cost per pound of product for 5-year amortization would be only about 2 cents a pound on the tin produced.

For 2 or 3 years longer, or until Far Eastern smelters resume production, operation of the Texas City reduction works is reasonably certain. Thereafter, in the absence of political control of ore sources by the United States, the future is unpredictable.

GOVERNMENT TIN PURCHASES

During 1944, 15,732 long tons of refined tin (13,850 in 1943) and 84,318 tons (gross weight) of ore and concentrates (55,000 in 1943) were purchased for Government account. Of the total quantity of ore and concentrates, 86 percent was acquired from Bolivia, 13 percent from Belgian Congo, and the remainder from French Cameroons and Mexico. The Bolivian ore was obtained under the 5-year contract with Bolivian producers that expires June 30, 1945; the portion from the Patiño group was received under a contract with Wm. Harvey & Co.

Two-thirds of the metallic tin acquired was from the Belgian Congo and the remainder from China. About 1,900 tons was stored in foreign ports or was afloat at the end of the year. Some Chinese tin was diverted to other destinations after being flown to India, and some was lost by enemy action.

Negotiations for a modification of the 5-year ore-buying contract more favorable to Bolivian producers continued during the year. On March 3, 1945, the Foreign Economic Administration announced that

the price to be paid for Bolivian tin during the remaining life of the basic tin agreement between Bolivia and the United States will be increased from 60 cents to 63½ cents. In addition thereto, the seller is to receive a bonus of 1½ cents a pound on the payable tin after unit deductions, "as an inducement to the seller to increase production." Thus, the effective increase is not 3½ but 5 cents a pound.² The price of 63½ cents is to be effective from December 19, 1944, to June 30, 1945, the date of expiration of the basic agreement. Inasmuch as the amendment had been under discussion since early 1944, it also provided for a retroactive increase of 2 cents a pound from July 1, 1944, to December 18, 1944. Provision is made for a new schedule of smelter charges designed to lend encouragement to the production of higher-grade ore and concentrates. The price increase also considered increases in wages and other production costs. Bolivia agreed to cooperate to keep production at the highest possible levels. The amendment contains a labor clause under which the producers agree to maintain standards of health and working conditions. In discussions with the Bolivian authorities in connection with the purchase of tin concentrates, the State Department was reported to have let it be known that it is not interested in extending government-to-government commodity contracts, and private business is expected to resume buying strategic materials when the war is over. An agreement was also reached to divert part of Patiño's shipments to the United States in 1945.

CONSERVATION

In the face of heavy drafts on stocks tin saving remained a matter of prime necessity. Only minor modifications of conservation or limitation orders were made in 1944. The general object was to permit manufacture or use of goods having superior properties or more closely adhering to industrial practices without increasing tin consumption.

Early in 1945 efforts were made to revive the lagging tin-can salvage campaign. Other secondary sources were drying up as a result of conservation measures first instituted in 1941, with reduction in tin plate coating-weight from the 1.5 pound per base box standard to 1.35 and the substitution of terneplate and black plate where feasible. (See sections on Secondary Production and Consumption by Uses.)

Electrolytic-tin-plate output of about 645,000 short tons was 95 percent greater than in 1943 and represented 30 percent of capacity. It amounted to 36 percent of standard coke-tin-plate tonnage, nearly twice the 1943 and 10 times the 1942 ratios. The average tin weight was 11.82 pounds per short ton compared with 26.24 pounds for standard cokes. The large share of tin plate used for military supplies precluded the full application of the thinly coated electrodeposited plate. Nevertheless, its use represented a saving of well over 4,000 long tons of tin. A material additional saving will arise when 0.75-pound plate is used for packing milk, announced to become effective in the third and fourth quarters of 1945. Although large-scale test results are not yet available, a new surface treatment for cans announced late in 1944 has distinct promise of promoting the use of

² The text of the amended Bolivian tin contract was published in *American Metal Market*, vol. 52, No. 52, Mar. 17, 1945, p. 5.

electrotinned plate. An alkaline detergent combined with a corrosion inhibitor is employed to film-packed cans, and the process is readily adaptable to cannery production lines. The film makes the exterior more resistant to rusting, a common cause of failure under humid conditions, than untreated hot-dipped plate. It has been found that some thin electrolytic plate test pieces show better corrosion resistance than others. Investigations were under way to discover the cause. If this fortuitous occurrence can be commercially repeated, the use of this class of tin plate for sanitary cans will be greatly enhanced.

In other use fields incomplete data render precise evaluation of conservation measures difficult. On a small sample, figures furnished the Bureau of Mines indicate that the average tin content of bronze and brass was approximately 5 percent in 1943 and 1944 and roughly 4 percent in 1939. For a group of manufacturers who used more than half the tin (primary plus secondary) contained in solders the approximate tin content was slightly less than in 1943 at 27 percent. In babbitt metal the total output was 30 percent greater, but the indicated tin content dropped sharply to about 14 percent, thus approaching the limit set up in Conservation Order M-43.

INVESTIGATIONS OF DOMESTIC TIN DEPOSITS

The Bureau of Mines and Geological Survey in 1944 continued investigations of tin occurrences as a part of their strategic mineral programs. Field examinations and explorations were made in the Gorman district of Kern County and the Cina district of San Bernardino, Calif.; in the Franklin Mountains near El Paso, Tex.; and in the Black Hills of South Dakota. In Alaska the most extensive work was carried out in the western part of the Seward Peninsula. Placer deposits in that area near Tin City furnished most (nearly 500 tons) of the domestic tin output in the last decade. Both placer and lode deposits have been examined.

The Geological Survey in a press release dated February 26, 1945, covering the work of the two agencies in Alaska in 1944 reported the discovery of tin-bearing veins in the Cape Mountain area. The deposits are of a type that could have been the source of large pieces of tin ore found in nearby stream gravels. Although the ore bodies are not large they make the outlook for additional discoveries more favorable than it was thought to be in the past. In the Lost River area tin has been found in veins, dikes, and mineralized zones cutting the limestone near the dikes. The dikes carry little tin at depth, but drill cores indicated a fair tin content in the veins and mineralized areas, as well as in the upper portion of a granite mass that lies a few hundred feet below the surface. The extent of the mineralized granite was being determined in 1944.

The report of the Director of the Bureau of Mines summarizing the results of work in the fiscal year ended June 30, 1944, stated that six deposits in Alaska and three in continental United States had been explored. In three of them a recoverable reserve of 3,450 tons of tin was indicated.

DOMESTIC PRODUCTION

MINE OUTPUT

Domestic production continued to be insignificant. The Metals Reserve Company discontinued the purchase of domestic and Alaska tin ores at its various depots December 31, 1944. Thereafter, terms of sale were to be furnished prospective sellers of tin ore upon application direct to Metals Reserve Company, Washington 25, D. C. The purchase depots acquired tin concentrates containing about 4 tons of tin in 1944, some of which had been mined in previous years.

Mine production of tin (content) in the United States, 1940-44, by States

Year	Long tons				Value
	Alaska	South Dakota	Other States ¹	Total	
1940.....	46	2	1	49	\$54,900
1941.....	46.8	1.4	8.1	56.3	65,600
1942.....	2.8	1.4	2.1	6.3	7,300
1943.....	.1	.6	5.2	5.9	6,800
1944.....	.....	(²)	(²)	5.4	6,200

¹ 1940: Montana and New Mexico; 1941: Alabama, Montana, and New Mexico; 1942: Alabama, California, Nevada, and New Mexico; 1943: California, Nevada, and New Mexico; 1944: California, New Mexico North Carolina, and South Dakota.

² Included in total.

SMELTER OUTPUT

Domestic tin smelters produced 30,884 long tons of tin in 1944 or nearly double the peak output in the first World War period. Most of it came from the Government-owned Longhorn smelter, and the remainder appeared largely in the form of alloys.

The 50-percent rise in pig-tin output at Texas City resulted from improved operating procedures in smelting and ore dressing, notably in lengthened furnace campaigns.

The principal plant improvements were the installation of mechanical samplers and conveyors for ore bedding in the ore-storage building and the addition of a thickener, filters, and a flotation unit for oxide flotation in the ore-dressing section. Near the end of the year two of the nine reverberatories were being converted to a single unit with a waste-heat boiler.

Satisfactory results were achieved with charges containing approximately 90 percent complex Bolivian ores of about 40 percent tin content (including the better-grade Patiño ores)—the first large-scale operation on ores of about 65 percent of the tin content of those usually smelted in England and about 55 percent of those smelted in Holland, Malaya, and the Netherlands East Indies. Although five grades of pig tin have been produced, recent practice has been to make only Three Star or Grade A (99.80 percent Sn and over) and no star or Grade F (less than 99 percent Sn). More than 80 percent of the output is of first quality. Representative analyses of the several grades are given in the following table. A summary of tin smelting practice in the United States, United Kingdom, and Malaya was published.³

³ Mantell, C. L., Recent Progress in Tin Smelting and Metallurgy: Trans. Am. Inst. Min. and Met. Eng., vol. 159, 1944, pp. 530-547.

New pyrometallurgical processes for the recovery of tin from tin sulfide concentrates or tin concentrates relatively high in sulfur and iron or from hardhead have been developed.⁴

Analyses of longhorn brands of tin

Brand	Percent									
	Sn	Sb	As	Pb	Bi	Cu	Fe	Ag	Cd	Ni and Co
Three Star.....	99.887	0.031	0.013	0.038	0.002	0.019	0.002	0.001	Nil	0.002
"C".....	99.654	.224	.047	.032	.001	.031	.003	.001	Nil	.005
Two Star.....	99.525	.300	.045	.075	.003	.040	.003	.002	Tr	.005
One Star.....	99.238	.417	.038	.145	.003	.144	.003	.002	Tr	.005
"F" (No Star).....	98.429	.978	.079	.104	.004	.381	.003	.002	Tr	.006

Longhorn smelter shipments were 37,112 long tons, of which 32,856 tons were Three Star and most of the remainder Grade F and One Star. Industrial users received about 25,100 tons, and the remainder was distributed to Government warehouses in Brooklyn, Chicago, St. Louis, and Texas City.

Only two privately owned smelters were in operation in 1944—the American Smelting & Refining Co. and the Nassau Smelting & Refining Co. Most of the tin recovered was as alloys, principally solder.

SECONDARY TIN

The total recovery of secondary tin decreased 14 percent in 1944 compared with 1943 to the lowest point since 1939—as scrap supplies dwindled. Decline in quality was also in evidence, especially in white metals, tin-plate clippings, and old containers. Detinning-plant output was the lowest since 1935 and 11 percent below that of 1943. Although the quantity of clean tin-plate clippings treated increased about 10 percent it was more than offset by the decrease in supply of old tin cans. Recovery was influenced further by a drop in tin content that was especially marked in used containers—about 15 percent—as a consequence of the growth in use of electrolytic tin plate and the limitation on weight of hot-dipped coatings.

Secondary tin recovered in the United States, 1925-29 (average) and 1940-44

Year	Tin recovered at detinning plants			Tin recovered from all sources			
	As metal (long tons)	In chemicals (long tons)	Total (long tons)	As metal (long tons)	In alloys and chemicals (long tons)	Total	
						Long tons	Value
1925-29 (average).....	900	2,000	2,900	7,500	23,100	30,600	\$38,034,120
1940.....	3,700	600	4,300	4,500	25,200	29,700	33,102,400
1941.....	4,500	950	5,450	5,300	32,200	37,500	43,722,700
1942.....	4,700	200	4,900	5,200	28,700	33,900	39,434,720
1943.....	3,900	200	4,100	4,700	29,100	33,800	39,332,800
1944.....	3,350	310	3,660	3,800	25,300	29,100	33,892,560

¹ Corrected figure.

⁴ Lebedeff, Yuri E., to American Smelting & Refining Co., Process for Treating Tin Sulfide Concentrates: U. S. Patent 2364727, Dec. 12, 1944; and Porter, Carroll B., to American Smelting & Refining Co., Method of Treating Tin Hardhead to Recover Tin: U. S. Patent 2364815, Dec. 12, 1944.

The Government-owned detinning plant at Birmingham, Ala., was in operation during the year. The wartime auxiliary operations of the National Lead Co. and the Tin Salvage Institute as agents for Metals Reserve Company ceased by the end of the year. The first named recovered 4.5 long tons of tin from old type metal in sodium stannate that was converted to metal at another plant, and the second had a production of about 485 tons of tin in the form of alloys. The totals for the campaigns were respectively 44.5 tons and 913 tons, virtually all as tin alloys.

Collection of used tin cans, part of which are employed for precipitating copper from mine waters, decreased nearly 12 percent or about 21,500 long tons compared with the 1943 returns, and the quantity of tin recovered dropped about one-quarter. The War Production Board amended Conservation Order M-325 further to direct delivery of old cans to detinners. In February 1945 the order again was amended, setting up country-wide mandatory provisions for collection, segregation, and disposal of used cans offered to refuse collectors: To insure continued collections the Metals Reserve Company in December 1944 agreed "to pay subsidies to detinners up to 13 cents a pound for all tin produced to compensate them for a loss in revenue that followed the drop in scrap steel price that took place late in the year." Further details on secondary tin will be found in the chapter on Secondary Metals—Nonferrous.

CONSUMPTION

APPARENT CONSUMPTION

In 1944 the apparent consumption of primary tin was 37 percent higher than in 1943. Apparent consumption is computed by adding domestic smelter production to net imports. It does not take into account fluctuations in consumer, dealer, and Government stocks; consequently, it may deviate widely from actual consumption as measured in finished products, which in 1944 was 36 percent above the calculated figure. Nevertheless, the apparent consumption series is useful as an indicator of long-term trend. The data for 1939-44 are given in the subjoined table:

Apparent consumption of tin, 1939-44, in long tons¹

1939-----	67, 987	1942-----	42, 512
1940-----	123, 537	1943-----	31, 749
1941-----	141, 618	1944-----	43, 379

¹ The series 1910-38 was published in Minerals Yearbook, 1939, p. 680. Exports of domestic tin were not included in 1931-41 inclusive. They are included in the figures for 1942-44 and are 244, 398, and 405, respectively.

CONSUMPTION BY USES

Actual consumption of primary and secondary tin as reported to the Bureau of Mines is shown in the following tables. Total consumption rose one-eighth above the 1943 low, whereas that of virgin metal jumped about more than a quarter in consequence of the growing scarcity of scrap, principally tin-bronzes, and bearing alloys, as well as degradation, and greater product requirements than in the preceding year. The product figures actually understate the use of new metal, inasmuch as tin contained in process scrap or other waste is considered as secondary.

The continued concentration of production on war materials brought no wide departure from the relative distribution of tin by primary uses reported in the 1943 review. Tin plate held first place as a user of virgin tin and took 42 percent of the consumption. The increase of 3,300 tons or 15 percent compared with 1943 was the net result of a 21-percent gain in the output of tin plate, of which 26 percent was electrotinned. In respect to solder, the prewar relationship between primary and secondary tin was resumed. Total tin use increased only 7 percent, but that of secondary fell 34 percent, whereas that of pig tin jumped 65 percent, a striking evidence of the effect of conservation through wide application of low-tin or virtually tin-free solders. Although the production of white-base bearing alloys rose nearly 20 percent to 61,464,334 pounds, according to the United States Department of Commerce the consumption of tin in babbitt was only 11 percent greater than in 1943 because of the permissible tin limit. The effect of earlier degradation coupled with some scarcity of scrap brought about abrupt reversal of the 1943 primary: secondary ratio of 3:4 to 2:1 in 1944. The attainment of a new peak in the shipbuilding program was principally responsible for an 11-percent increase in total tin consumption for bronze and brass; almost all of it was virgin metal and accounted for nearly one-quarter of its use. Bronze and brass thus remained in second position as primary tin consumers for the second year and in total tin used exceeded tin plate by essentially the same margin as in 1943. In other fields of use, roughly 20 percent or 950 tons more virgin tin was consumed than in the preceding year. The planned industry reconversion and military matériel cut-backs to follow the cessation of war in the European theater probably will bring about reversion to the peacetime relative positions in the four major use areas. However, the quantitative distribution will be modified, owing to the scarcity of virgin tin.

Consumption of primary and secondary tin in the United States, 1940-44, in long tons

	1940	1941	1942	1943	1944
Stocks on hand Jan. 1.....	29,025	56,999	¹ 67,421	² 43,853	³ 34,735
Net receipts during year ⁴	128,030	149,123	65,568	75,101	86,970
Available supply.....	157,055	206,122	132,989	118,954	121,705
Stocks on hand Dec. 31.....	56,999	¹ 67,421	² 43,853	³ 34,735	³ 27,391
Total processed during year.....	100,056	138,701	89,136	84,219	94,314
Intercompany transactions in scrap (tin content).....	2,190	2,936	2,547	2,889	3,205
Total consumed in manufacturing.....	97,866	135,765	86,589	81,330	91,109
Plant losses.....	712	1,070	902	1,000	1,140
Tin content of manufactured products.....	97,154	134,695	85,687	80,330	89,969
Primary.....	⁵ 72,324	⁶ 103,086	56,288	46,253	59,156
Secondary.....	24,830	31,609	29,399	34,077	30,813

¹ Not including 2,700 tons in transit or in warehouses.

² Not including 78 tons in transit.

³ Not including 316 tons in transit or in warehouses.

⁴ 1940: Primary, 98,125; secondary, 5,409;terne, 1,086; scrap, 23,410. 1941: Primary, 114,281; secondary, 6,579;terne, 1,851; scrap, 26,112. 1942: Primary, 33,126; secondary, 5,096;terne, 405; scrap, 26,941. 1943: Primary, 40,548; secondary, 4,462;terne, 188; scrap, 29,903. 1944: Primary, 55,323; secondary, 2,536;terne, 228; scrap, 26,883.

⁵ Not including 1,941 tons in transit or in warehouses.

⁶ Includes small tonnage of secondary pig tin.

Consumption of tin in the United States, 1942-44, by finished products (tin content), in long tons

Product	1942			1943			1944		
	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total
Tin plate.....	28,522	-----	28,522	21,684	42	21,726	24,968	-----	24,968
Terneplate.....	339	543	882	100	334	434	510	230	740
Solder.....	7,228	6,696	13,924	5,292	7,384	12,676	8,786	4,841	13,627
Babbitt.....	3,195	2,904	6,099	3,217	4,536	7,753	5,790	2,986	8,786
Bronze and brass.....	10,646	17,009	27,655	11,180	18,575	29,755	13,768	19,327	33,095
Collapsible tubes.....	1,048	51	1,099	282	309	591	283	242	525
Tinning.....	2,764	251	3,015	2,690	324	3,014	2,771	370	3,141
Foil.....	576	-----	576	227	145	372	226	92	318
Chemicals (other than tin oxide).....	36	210	246	112	299	411	34	259	293
Pipe and tubing.....	143	18	161	82	118	200	230	32	262
Tin oxide.....	84	47	131	-----	-----	-----	-----	-----	-----
Type metal.....	40	1,113	1,153	28	1,033	1,061	49	1,302	1,351
Galvanizing.....	82	-----	82	4	-----	4	-----	-----	-----
Bar tin.....	601	121	722	685	276	961	1,092	167	1,259
Miscellaneous alloys.....	558	256	814	360	566	926	417	707	1,124
White metal.....	183	156	339	90	55	145	19	86	105
Miscellaneous.....	343	24	367	220	61	281	213	162	375
	56,288	29,399	85,687	46,253	34,077	80,330	59,166	30,813	89,969

¹ Includes 9 tons of primary and 2 of secondary for britannilware and 2 tons of primary for pewter.

² Includes 6 tons of secondary for pewter.

FOREIGN TRADE ⁵

Imports of tin concentrates and exports of tin plate were the principal elements of the foreign trade in tin of the United States during 1944. Pig tin ceased to dominate the import field in 1943, as this country was denied access to former Asiatic sources. There was slight improvement in the situation with the resumption in April of imports of Chinese tin, which had been flown out and shipped from India. Consequently imports of metallic tin increased (11 percent), despite a 13-percent decline in receipts from the Belgian Congo, our main source of foreign pig tin at present.

The Longhorn smelter, Texas City, Tex., was the destination of virtually all tin concentrates imported in 1944. The tin content of the material imported was 36,504 tons (21,857 in 1943), establishing a new record by exceeding the 1942 imports of 28,933 tons, the previous high. Bolivia continued to be the principal source, supplying 28,544 tons compared with 17,351 in 1943. The increase was due to acquisition of a large tonnage of concentrates produced by the Patiño group. Imports from other sources included: Belgian Congo, 7,549 tons (4,094 in 1943); French Africa, 177 (291 in 1943); Peru, 146; Mexico, 46 (121 in 1943); and Argentina, 42.

Exports of tin plate, terneplate, and taggers tin increased 10 percent in 1944. For the most part they went to Latin-American countries (31 percent) and Australia and New Zealand (31 percent), which increased 9 and 5 percent, respectively. Exports to Russia (accounting for 10 percent of the total) increased 53 percent; those to India (8 percent), 52 percent; and those to African destinations (8 percent),

⁵ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

9 percent. Exports to Canada (8 percent) declined 4 percent and those to miscellaneous countries (4 percent), (principally Egypt), 19 percent.

Foreign trade of the United States in tin and tin concentrates, 1940-44

Year	Imports				Exports of tin (metal) ¹ (long tons)
	Tin (metal)		Tin concentrates (tin content)		
	Long tons	Value	Long tons	Value	
1940.....	124, 810	\$128, 294, 410	3, 000	\$2, 687, 154	2, 664
1941.....	140, 873	149, 569, 328	28, 670	27, 671, 689	1, 094
1942.....	26, 753	29, 311, 113	28, 933	21, 422, 896	165
1943.....	12, 030	13, 089, 540	21, 857	24, 804, 842	1, 372
1944.....	13, 338	15, 049, 200	36, 504	25, 408, 014	438

¹ Imported as pigs, bars, etc., and exported as such.

² In addition 244 tons of ingots, pigs, etc., were exported in 1942, 398 tons in 1943, and 405 tons in 1944; accounted for as domestic exports in "exports of miscellaneous tin manufactures."

Tin¹ imported for consumption in the United States, 1943-44, by countries

Country	1943		1944	
	Long tons	Value	Long tons	Value
Belgian Congo.....	11, 550	\$12, 686, 414	10, 000	\$11, 199, 813
British Malaya.....	5	6, 180	(?)	110
Canada.....	1	1, 025	(?)	13
China.....			3, 338	3, 849, 251
India and Dependencies.....	(?)	57		
New Zealand.....	110	6, 759		
Portugal.....	364	389, 105		
United Kingdom ²			(?)	13
	12, 030	13, 089, 540	13, 338	15, 049, 200

¹ Bars, blocks, pigs, grain, or granulated.

² Less than 1 ton.

³ United Kingdom of Great Britain and Northern Ireland.

Foreign trade in tin plate, taggers tin, and terneplate in various forms, 1940-44, in long tons

Year	Tin-plate scrap		Tin-plate circles, strips, cobbles, etc. (exports)	Waste-waste tin plate (exports)	Terneplate clippings and scrap (exports)	Tin plate, taggers tin, and terneplate	
	Imports	Exports				Imports	Exports
1940.....	16, 615	3, 536	4, 590	6, 091	15, 153	137	383, 328
1941.....	22, 600	180	4, 952	8, 321	751	109	354, 940
1942.....	24, 082		1, 333	3, 230	76	134	593, 776
1943.....	19, 591	27	1, 607	50	56	101	396, 550
1944.....	17, 323	112	1, 294	2, 868	161	112	436, 866

Foreign trade in miscellaneous tin manufactures and tin compounds, 1940-44

Year	Miscellaneous tin manufactures		Tin compounds (pounds)	
	Imports ¹	Exports ²	Imports	Exports
1940.....	\$12,429	\$706,425	271	131,019
1941.....	2,266	1,456,353	7,224	137,424
1942.....	1,949	591,937	-----	117,191
1943.....	³ 2,425	666,476	-----	25,042
1944.....	³ 3,682	1,294,369	-----	25,992

¹ Includes tin manufactures, n. s. p. f., tinfoil, tin powder, flitters, and metallics.² Includes tin dross and tin-bearing scrap material other than tin-plate scrap.³ In addition 505,346 pounds of tin dross, skimmings, and residues valued at \$63,978 were imported in 1942, 5,943 pounds valued at \$4,595 in 1943, and 108,296 pounds valued at \$9,536 in 1944.*Tin plate, terneplate (including long ternes), and taggers tin exported from the United States, 1943-44, by principal countries*

Country	1943		1944	
	Long tons	Value	Long tons	Value
Africa:				
British:				
British East Africa.....	3,467	\$365,901	1,812	\$182,933
Southern Rhodesia.....	495	64,836	280	32,498
Union of South Africa.....	23,593	2,745,819	27,818	3,644,573
Argentina.....	25,292	3,156,685	34,490	4,160,362
Australia.....	97,260	11,689,051	119,212	14,283,304
Brazil.....	42,664	5,103,297	52,262	6,377,372
Canada.....	38,744	4,316,057	37,030	3,895,405
Ceylon.....	1,275	126,115	718	85,601
Chile.....	6,862	848,156	3,917	464,674
China.....	1,147	146,936	-----	-----
Colombia.....	3,908	457,512	841	107,614
Cuba.....	10,197	1,298,730	10,902	1,379,511
Egypt.....	16,071	1,526,195	926	93,134
India and Dependencies.....	20,079	1,984,008	30,858	3,332,626
Madagascar.....	1,032	120,806	2,440	283,517
Mexico.....	13,646	1,735,744	14,195	1,736,427
Morocco, French.....	2,951	335,478	3,304	395,699
New Zealand.....	29,381	3,525,542	13,893	1,650,385
Palestine and Trans-Jordan.....	908	93,868	-----	-----
Paraguay.....	2,650	317,897	1,622	194,452
Peru.....	1,634	202,323	1,515	416,623
Portugal.....	1,360	169,845	8,035	988,862
Turkey.....	152	19,117	3,051	284,738
U. S. S. R.....	29,881	3,569,629	45,681	5,514,567
United Kingdom ¹	85	10,032	344	40,354
Uruguay.....	16,344	1,995,187	15,146	1,948,690
Venezuela.....	1,458	175,092	1,362	177,511
Other countries.....	4,014	514,791	5,212	639,552
	396,550	46,614,649	436,866	52,320,984

¹ United Kingdom of Great Britain and Northern Ireland.**PRICES**

The price of tin remained stabilized in the United States at established Government maximums or ceilings throughout 1944. Under Maximum Price Regulation 17 (Tin) issued by the Office of Price Administration, September 16 (effective September 22, 1943), the maximum prices, by grades and brands, are as follows:

Grade A. 99.80% or higher, meeting specifications set forth in M. P. R. No. 17.....	52.00c.
Following brands of pig tin will be considered as qualifying as Grade A: Longhorn 3-Star, Chempur, Pyrmont, Straits Trading, O. T. Lempriere & Co., E. S. Coy (Penang), Billiton, Mellanear (Guar. 99.9%), Hawthorne Refined, Banka, Union Min. du H. Katanga, M and T No. 1, M and T Electrolytic Refined, Vulcan American Refined, Vulcan Electrolytic.	
Grade B. 99.80% or higher, not meeting specifications for Grade A, providing arsenic content does not exceed 0.05%.....	51.87½c.
Grade C. 99.65% to 99.79% and 99.80% or higher, not meeting specifications for Grade A or Grade B.....	51.62½c.
Grade D. 99.50% to 99.64% (includes Longhorn 2-Star).....	51.50c.
Grade E. 99.00% to 99.49% (includes Longhorn 1-Star).....	51.12½c.
Grade F. Below 99% pure (for tin content) (includes Longhorn No-Star).....	51.00c.

On January 1, 1944, the London price was advanced £25 per ton to £300 for metal ranging between 99 and 99.75 percent tin content.

Tin price data, 1925-29 (average) and 1940-44

	1925-29 (average)	1940	1941	1942	1943	1944
Average prices:						
New York:¹						
Straits tin..... cents per pound..	56.64	49.82	52.01	\$ 52.00	\$ 52.00	\$ 52.00
99.75-percent tin (English refined).....	(²)	48.79	(²)	\$ 51.625	\$ 51.625	\$ 51.625
cents per pound.....	(²)	49.98	51.26	51.125	51.125	51.125
99-percent tin..... do.....	55.50					
London:³						
Standard tin..... £ per long ton.....	254.6	256.6	\$ 261.6	10 275.0	10 275.0	10 300.0
Do..... cents ¹¹ per pound.....	55.17	43.87	47.09	49.54	49.54	53.59
Premium allowed over standard:						
Straits..... £ per long ton.....	5.1	(²)	(²)	(²)	(²)	(²)
Banka..... do.....	6.9	(²)	(²)	(²)	(²)	(²)
English..... do.....	— .7	(²)	(²)	(²)	(²)	(²)
Price indexes (1925-29 average = 100):						
Straits tin (New York).....	100	88	92	92	92	92
Copper (New York).....	100	77	80	80	80	80
Lead (New York).....	100	69	78	87	87	87
Nonferrous metals ¹²	100	82	85	87	87	87
All commodities ¹³	100	80	89	101	105	106

¹ American Metal Market.

² Maximum for Grade A, 99.8 percent or higher (includes Straits).

³ Data not available.

⁴ 7-month average.

⁵ January-August, nominal; September-December, 51.62 cents.

⁶ Maximum for Grade B, 99.75-99.79 percent, and Grade C, Cornish refined.

⁷ Maximum for Grade D, 99.0-99.74 percent.

⁸ Metal Bulletin, London, as compiled by International Tin Research and Development Council.

⁹ 11-month average.

¹⁰ British Government maximum price.

¹¹ Conversion of British quotations into American money based upon average rates of exchange recorded by the Federal Reserve Board of the Treasury.

¹² Based upon free exchange rate.

¹³ Based upon price indexes of U. S. Department of Labor.

According to The Metal Bulletin (London), issue of January 30, 1945:

There are no international prices of tin at the present time, for although the official selling prices in the United States and in the United Kingdom are roughly in line—tin-hungry neutrals and liberated countries would probably be prepared to pay almost anything for urgently needed supplies. It is known that prices upwards of £60 a ton more than the official selling price in this country (United Kingdom) have been paid for export business, and it is suggested that £400 could readily be obtained in some directions if it were possible to send the tin.

STOCKS

Total year-end stocks of primary tin plus tin content of the ore and concentrate supply in the United States in 1944 were 12 percent below 1943. The Government held 81 percent and private industry the remainder. The quantity (in terms of tin content) held by the Government was divided about equally between metallic tin and in ores and concentrates. Government stocks of pig tin were depleted 26 percent and industrial stocks 17 percent. Virtually all the industrial stocks were in the form of metal; only a very small quantity was in ores awaiting treatment at privately owned plants. The total quantity on hand was equivalent to about 1.6 years supply at the rate of consumption in 1944. However, if consumption continues at the 1944 level and the flow of supplies are likewise maintained, the stock pile would be sufficient for about 7 years.

The Bureau of Mines canvassed tin consumers to determine stocks and use during 1944. According to these reports, the consuming industry had 17,337 tons of primary pig tin at plants at the end of 1944, including 8,442 tons held by tin-plate manufacturers. The industry also had 1,941 tons of primary tin in transit or warehoused in addition to 49 tons of secondary pig tin on hand at the end of the year.

Stocks of virgin pig tin in the United States, Dec. 31, 1940-44, in long tons

	1940	1941	1942	1943	1944
Location of stocks:					
Afloat to United States ¹	22,627	² 15,000	² 900	² 1,650	² 1,800
At landings in New York ¹	6,106	3,129	(?)	(?)	(?)
In licensed warehouses in New York ¹	3,073	371			
Total visible supply¹.....	31,806	18,500	² 900	² 1,650	² 1,800
Consumers' stocks⁴.....	46,574	⁵ 50,922	⁶ 31,226	⁷ 23,227	⁸ 19,325
Total stocks on hand.....	⁹ 78,380	⁹ 75,422	⁹ 32,126	⁹ 24,877	⁹ 21,125

¹ As reported by Commodity Exchange, Inc.

² Estimated.

³ Not available.

⁴ As reported to the Bureau of Mines; do not include tin in process or secondary pig tin.

⁵ Includes 2,700 tons in transit in the United States and at other warehouses not contained in figures above for "at landings" and "in licensed warehouses."

⁶ Includes 78 tons in transit and 84 tons held by jobbers.

⁷ Includes 316 tons in transit and at other warehouses and 50 tons held by jobbers.

⁸ Includes 1,941 tons in transit and at other warehouses and 47 tons held by jobbers.

⁹ Exclusive of Government purchases delivered for stock-piling or at Texas City smelter;

WORLD ASPECTS OF TIN INDUSTRY

WORLD MINE PRODUCTION

Official information on mine production in tin-producing countries is still meager. However, it appears probable that the total output was even below the estimated total for 1943 and insufficient to balance consumption. Allied military successes in the Far East contributed thereto, and it seems likely that the decline will continue until the Japanese have been driven out of tin-producing regions in the Pacific area. There is growing evidence that in other parts of the world the higher grade and more accessible portions of deposits have been mined and that development has not paced extraction.

World mine production of tin (content of ore), 1925-29 (average) and 1933-44, by countries, in long tons

[Compiled by B. B. Waldbauer]

Country	1925-29 (average)	1939	1940	1941	1942	1943	1944
Restricted production:							
Belgian Congo	967	8,964	12,482	16,190	16,191	17,480	15,400
Bolivia (exports)	37,169	27,211	37,940	42,199	38,293	40,312	39,341
Indochina	691	1,470	2,098	1,430	1,400	1,000	500
Malay States:							
Federated	54,606	49,525	85,384	78,000	15,000	15,000	10,000
Unfederated	2,206	1,994					
Straits Settlements	25	206					
Netherlands Indies	33,266	27,755	43,193	51,000	10,000	7,500	5,000
Nigeria	8,319	9,427	12,012	15,000	12,500	12,654	12,300
Thailand (Siam)	8,204	17,325	17,447	16,250	12,000	7,600	5,000
Total signatory countries	145,453	143,877	210,556	220,000	105,000	101,000	87,500
Unrestricted production:							
Argentina	32	1,655	1,481	921	998	1,700	792
Australia	2,830	3,500	4,200	3,500	3,000	2,500	2,400
Burma	2,228	8,536	5,500	(3)	(3)	(3)	(3)
Cameroun, French		243	188	220	233	194	161
China	7,085	10,422	6,249	8,000	7,000	5,000	3,000
Germany	98	1,300	(3)	(3)	(3)	(3)	(3)
Italy		256	309	230	(3)	(3)	(3)
Japan	625	1,700	(3)	(3)	(3)	(3)	(3)
Mexico	2	289	345	212	365	426	317
Morocco, French	4	31	20	26	4	11	9
Peru		47	72	47	75	69	(3)
Portugal	625	1,486	1,721	2,330	2,670	3,460	1,800
Portuguese East Africa	5	7	6	4	10	6	(3)
Rhodesia:							
Northern			16	10	(3)	(3)	(3)
Southern	15	451	(3)	239	162	(3)	(3)
South-West Africa	149	156	137	120	110	158	122
Spain	145	106	100	103	239	205	500
Swaziland	138	114	103	131	113	109	77
Tanganyika (exports)	98	224	254	247	193	159	124
Uganda (exports)	22	354	334	302	200	213	(3)
Union of South Africa	1,174	482	518	463	508	526	1,000
United Kingdom	2,659	1,633	1,620	1,509	1,363	1,359	1,100
United States	24	34	49	56	6	6	5
Total nonsignatory countries	17,957	32,026	25,300	26,300	20,300	16,500	12,600
Grand total	163,000	176,000	236,000	246,000	125,000	118,000	100,000

¹ Estimates by the authors. ² Exports. ³ Estimate included in total.

⁴ Restricted production basis from 1934-36, inclusive.

⁵ Estimate includes Rhodesia, and Uganda.

WORLD SMELTER PRODUCTION

Output of the world's operating smelters, principally concentrated in 1944 in the Belgian Congo, United Kingdom, and United States, was keyed to the new ore supply, and hence world tin-smelter output probably reached a new low point for over 2 decades. For the first time on record the United States attained first place in the production of refined tin.

The modern 30,000-ton smelter of the N. V. Nederlandsche Metallurgische Bedrijven, a subsidiary of the Billiton Company, at Arnhem, Holland, was damaged extensively during the European campaigns. No information has been disclosed concerning its possible reconstruction. It has been assumed generally that Malayan and Netherlands East Indies smelters also have been or will have been destroyed before the war terminates.

World smelter production of tin, 1925-29 (average) and 1939-44, by countries, in long tons

[Compiled by B. B. Waldbauer]

Country	1925-29 (average)	1939	1940	1941	1942	1943	1944
Argentina.....		1,080	881	768	709	552	500
Australia.....	2,952	3,300	13,500	15,000	13,000	14,000	13,000
Belgian Congo.....		2,124	7,832	11,818	13,963	11,068	10,000
Belgium ¹	720	3,100	(²)	(²)	(²)	(²)	(²)
British Malaya.....	488,855	481,536	126,945	125,000	10,000	15,000	15,000
Canada.....				29	560	347	231
China.....	7,080	10,850	13,000	10,000	7,910	4,349	2,160
Germany ¹	3,444	3,600	(²)	(²)	(²)	(²)	500
Italy.....		146	330	72	(²)	(²)	(²)
Japan.....	606	2,000	1,800	(²)	4,000	(²)	2,000
Mexico.....	(²)	90	116	150	320	395	286
Netherlands.....	1,000	14,600	2,967	(²)	(²)	(²)	(²)
Netherlands Indies ⁴	14,749	13,941	22,035	23,000	5,000	5,000	11,000
Norway.....	(²)	283	(²)	(²)	(²)	(²)	(²)
Portugal.....	2	30	781	1,481	2,381	3,058	(²)
Spain.....		138	112	86	99	121	126
Thailand (Siam).....	113	(²)	(²)	(²)	(²)	(²)	(²)
Union of South Africa.....			33	143	535	862	1,250
United Kingdom ¹	45,800	37,400	(²)	40,000	30,000	31,026	25,000
United States.....			11,391	11,839	16,168	21,489	30,884
	165,000	174,200	(²)	(²)	(²)	(²)	(²)

¹ Estimates by the authors.

² Data not available.

³ Yearbook of American Bureau of Metal Statistics.

⁴ Exports plus difference between carry-over at end and beginning of year.

⁵ Exports.

⁶ Unoccupied China.

⁷ Includes production of some secondary tin.

⁸ Estimated production in 1929.

⁹ Average for 1926-27.

¹⁰ Average for 1926-28.

¹¹ Including tin content of ores used direct to make alloys.

INTERNATIONAL TIN CONTROL SCHEME

Extension of the fourth control agreement that expires December 31, 1946, has become the subject of much discussion abroad and in the United States. The arguments are of more than usual interest because of the entrance of new and important factors: The attitude of the American Government toward cartels; the future of large-scale domestic tin smelting; and the anticipated recovery of the Malaysian tin areas more or less coincidentally with termination of the present agreement.

Proponents of control measures advance in general arguments set forth in the past and more recently by the Tin Producers' Association (an operators' group). Some elements, nevertheless, recognize that, as now constituted, the International Tin Committee (ITC) (essentially a group representing the tin interests of the major tin-producing countries) would not be adequate to fulfill the postwar requirements of the main consuming and producing countries. To meet this difficulty it has been suggested that consuming (or smelting) countries might be given an active voice in ITC deliberations and that the United States Government might not be averse to such participation. Reference was made in the chapter of this series in Minerals Yearbook, 1943, to a historical review of the International Tin Control and Buffer Stocks as presented by the Tin Producers' Association.⁶ According to the association, the main functions of the ITC were "to prevent excessive accumulations of stocks and to provide an ample supply of

⁶ Also appeared in 1944 as pamphlet under above title.

tin at a reasonable price." Industrial stability is obtained only when there is close equilibrium between supply and demand. In the instance of tin, this was to be gained by control of exports from the countries signatory to the International Control Scheme operated by ITC, which would insure a balance over relatively long periods. Tin demand, however, fluctuates sharply and rapidly and independent of price. It thus became necessary to develop an auxiliary regulatory device—a surge tank—which was accomplished in the form of the so-called buffer stocks. Through the application of this two-part system, it was claimed, both producers and consumers benefitted, because prices were held at reasonable and stable levels compared with those of the preceding uncontrolled period. The war demonstrated further the advantage of a control that brought about maintenance of productive capacity through the depression period.

Opponents of restriction schemes state, among other things, that the control operated to hold prices at such a height that operations were remunerative to marginal and uneconomic producers. Much redundant capacity thereby was kept in being, and consumers suffered through excessive prices. The proposed solution to these and other attendant ills is a return to free competition. In a well-documented review of the operations of the ITC, A. J. Knorr⁷ comes to essentially the same conclusion. He avers that the committee failed to control excessive price gyrations although successful in maintaining very high prices that were profitable to the entire producing industry, including an obsolescent section; and that the total cost of control was borne by the ultimate consumer. Inasmuch as the control was political, that is, governed by producers and producing countries, and though it was susceptible to some economic motivation—control of production was not complete nor was consumption regulated—it was undesirable and ineffective with reference to the greatest social good. A tight commodity control in practice is likely to develop evils worse than those of an unregulated market.

A definite solution to the problem is not offered, but in view of the well-organized and strongly backed efforts to extend control some proposals are tendered. It is taken for granted that the United States, as the major consumer, will have considerable influence in the matter. In the transition period, until rehabilitation in Far Eastern tin fields has been completed, the wartime controls exercised by the United Nations should not be relaxed. This would insure equitable distribution of supplies and prevent runaway prices. Over-expansion of productive facilities could be discouraged or limited by Government and producer-group cooperation. Intensive research—economic and technical—should be continued to afford a sound groundwork for decision as to the desirability of longer-term control. To attain production-consumption equilibrium lengthy control would be necessary to ameliorate the losses to owners of superfluous capacity. Bolivia presents a special and difficult case. It is the highest-cost producer; Bolivian economy depends almost completely on tin production. Only a radical solution is possible. In substance the burden must mostly fall on the United States, possibly a share being borne by the United Kingdom. The author does not agree with the Tin Producers' Association statement that buffer stocks can be made an adjunct of a

⁷ Knorr, A. J., *Tin Under Control*: Food Research Institute, Stanford University, Calif., January 1945, 314 pp.

restriction scheme because no such scheme has been devised to concentrate and maintain production only in economic units. Alone they can, however, moderate short-term excessive fluctuations in price from the secular trend if intelligently and impartially directed. It is obvious that they must be large in size because of supply rigidity and consumer tendency to maintain low stocks when visible supplies are large. Such stocks might be considered, at least in part, as strategic reserves.

On the whole, Dr. Knorr is inclined to believe that vested interests will not adopt the suggested plans, consequently a free tin market would be preferable to that heretofore maintained by ITC.

REVIEW BY COUNTRIES

Australia.—Tin production in Australia in 1944 was probably the lowest recorded for any year during the past decade. Tin stocks were depleted so that it became necessary to divert some Chinese tin to meet essential requirements in Australia and New Zealand. Mining was handicapped by labor shortages and was adversely affected by a drought of unprecedented severity. Operations by the Tableland Tin Dredging, N. L., Mount Garnet, Queensland, now the leading tin producer in Australia, proceeded at a greatly increased rate during most of 1944. Output by Briseis Consolidated, N. L., in Tasmania, the second largest producer, was much lower, as the grade of ore decreased materially and manpower difficulties grew. Production of tin in Tasmania declined sharply during the year ended June 30, 1944, according to the annual report of the Minister for Mines. A Government subsidy of £A3,000 was granted for development work in the Renison Bell tin area in Tasmania. The Mount Bischoff mine controlled by Government was worked by leasers; operations were confined mainly to sections of the open-cut. The Minister of Supply offered to buy concentrates containing 70 percent tin or more from miners and prospectors at £A231 per ton. The Australian Council for Scientific and Industrial Research reported the development of a new flotation process for recovery of tin from lode-tin ores. The method was said to be applicable to both current and old tailings.

Belgian Congo.—Production of tin ore and concentrate declined 12 percent in 1944 from the record established in 1943. The remarkably rapid development of tin mining in the country is revealed by the fact that approximately two-thirds of the total recorded output was made during the period 1940–44. This was mainly owing to the insistence of the Belgian Government on maximum production as an aid to the Allied cause. The decline in output in 1944 resulted in part from transition to lower-grade ores, from drought conditions, and perhaps from some resumption of gold-mining operations.

The United States Government contracted for the purchase of all tin produced in the Belgian Congo during 1944, understanding that a part thereof would be made available to Belgium whenever that country was liberated. Metallic tin and tin in ore and concentrates imported by the United States from the Belgian Congo declined 11 percent in 1944. Metallic tin imported was 10,000 tons (11,550 in 1943) and 7,549 tons in ore and concentrates (4,094 in 1943).

Belgium.—The restoration of the port of Antwerp and its vicinity probably means early resumption of tin smelting by the Soc. Gén.

Métallurgique de Hoboken. The capacity of the plant was formerly rated at 10,000 tons of U. M. H. K. brand of tin annually which was produced mostly from tin ore mined in the Belgian Congo. Some pig tin and tin ore from the Belgian Congo may be diverted to Belgium from the Congo via the United States in 1945.

Bolivia.—Since the inception of the first International Tin Control Scheme in 1931 Bolivia exceeded its standard quota four times but on the average for the full period has failed to meet it by more than 7,000 long tons annually. Concentrates and ore exported contained 38,719 long tons of tin in 1944, a 4-percent decrease compared with 1943. However, with the exception of 1943 and 1941, the quantity was greater than in any year since the peak production of 46,341 tons in 1929. The United States was the destination of about 19,568 tons or 51 percent, and the remainder went to the United Kingdom. United States general imports in 1944 from Bolivia were 28,584 tons (including 7,504 tons from Patiño's 1943 production) and 12,377 tons (gross weight) were afloat destined to the United States at the end of the year. About half (10,000 tons) of the Patiño-group output in 1945 will be shipped to the United States in 1945. In general, the decrease in exports in 1944 was due to several adverse factors, including cessation of operations by several medium producers, labor troubles, and political unrest. Exports reached a very high level in September owing to delayed shipment of mill accumulations. The exports of the Patiño group, the principal producer, amounting to 49 percent of the total, declined 6 percent; those of the Hochschild group, 26 percent, declined 1 percent compared with 1943; and the medium and small mines, with 19 percent, declined 4 percent. Tin Placers Corp. suspended operation of its dragline and washing plant September 15 and is now reported to be bankrupt. Under a November 1942 contract the company delivered about 287 long tons (gross weight) of tin ore to the Metals Reserve Company.

After long-drawn-out negotiations a second amendment to the 5-year Bolivian-United States ore-purchase contract, expiring June 30, 1945, was signed on March 3, 1945. It provided principally for upward revision of price over that of the first amendment (60 cents a pound tin content f. o. b. South American ports) which for about 6½ months before the contract ends was 3½ cents plus a bonus of 1½ cents a pound. The small miners' group (mineros chicos) represented by the Banco Minero was favored by permission to ship a higher proportion of low-grade concentrate (below 35 percent payable tin to the 18-percent rejection point) than the other sellers without treatment penalty. In view of the probable delivery of an excess of low-grade material over that desirable for balanced operation at the Longhorn smelter, the U. S. Commercial Company has arranged to sell and ship in 1945 any excess to the Vulcan Detinning Co. at Seward, N. J.

No new mining taxes appear to have been levied by the Bolivian Government in 1944. Nevertheless it acted to increase the cost of mining by social and labor legislation, including additional pay for night work, increased employer contributions for compensation insurance, severance pay, wage payments for 12 holidays, and Christmas bonuses. After the amended contract was signed the valuation of ore and concentrates for export-tax purposes was raised to the contract price levels plus 1½ cents, the difference between f. o. b. and c. i. f.

prices. It was also decreed in April 1945 that 60 percent of the foreign exchange received for exports could be requisitioned for conversion to bolivianos, compared with 42 percent theretofore.

The new \$750,000 sink-and float-process plant that had been completed at Llallagua (Catavi) by the Patiño group late in December was expected to be in full and successful operation by March 1945. Its capacity is 5,500 tons per day, and it will be used for mine ore or tailings. The newly designed \$140,000 Sullivan tilting-deck tables installed at the Catavi and Centenario mills to treat very fine slimes that now are lost in the tailings were expected to be brought into full operation early in 1945. They are rated at 1,000 tons a day. The \$1,250,000 Tainton-process pilot plant of about 250 tons daily capacity at the Hochschild-operated Potosi properties was completed in October, and although trial runs have indicated that the metallurgical aspects of the plant are successful certain mechanical difficulties remain to be remedied.

The Bolivian Government has continued to contribute to the Tin Research and Development Council at London, doubling its previous contributions in 1944. The amount was reported to have exceeded £7,000.

British Malaya.—Authentic news regarding the tin mines and smelters of British Malaya has been entirely lacking during 1944. Dredging was formerly the principal means of tin-ore production. Resumption of production by dredging probably will be a slow process after the Japanese have been driven out; some Britishers have expressed the opinion that 5 to 10 years may elapse before the various enterprises can hope fully to reestablish their separate undertakings.

Mining ores by hydraulic sluicing, gravel pumping, hand panning, and other methods may provide an appreciable output of high-grade concentrates without much delay. These mining methods were formerly favored by individual Chinese miners, particularly gravel-pumping operations because of the small capital required and suitability for effectively mining small areas. The majority of the hydraulic mines (of which there were over 100) were small Chinese workings in the hill areas depending upon ditches for water supply. "Dulang washing" formerly contributed about 2 percent of the total output. As these several types of mining methods contributed almost 40 percent of Malaya's output in 1939 they may be expected to be able to supply up to 1,800 tons of tin per month soon after communications have been restored. Production from these sources was probably very small in 1944 because of resistance of Chinese to the invaders, shortage of food, oil, and other supplies and sabotage of Japanese-supported or enforced operations.

The Malayan Chamber of Mines has continued its efforts to impress upon the British Government the urgent need for prompt action on a definite plan for compensation of war-damage losses and for financial assistance in reequipping mines so that they may resume operations as soon as the Japanese have been driven out of the tin fields.

Burma.—The production of tin ore in Burma was not large in the past; in 1939 it contained about 8,500 tons of tin. No definite information on output has been disclosed since 1939, but prospects are now favorable for the resumption of tin mining. The Japanese overran the country in 1942, and by early 1945 rapid progress was being made by the Allied military forces in driving them out. Rangoon

had been recovered, and by May 1945 British forces were moving steadily down the road southeast of Toungoo toward the property of Mawchi Mines, Ltd., an important producer.

Canada.—Tin continued to be recovered as a byproduct in the treatment of the silver-lead-zinc ores of the Sullivan mine in British Columbia. Production was 231 tons in 1944 compared with 347 in 1943. The concentrate assays about 64.9 percent tin and 0.22 percent lead. Electrolytic refining is employed because of the difficulty of otherwise controlling the lead content in refined metal. An average assay of the pig tin is: Sn 99.647, Pb 0.31, Bi 0.002, Cu 0.006, Fe 0.006, Co 0.004, Al 0.005, Mn 0.005, and Zn 0.005 percent. According to Warren and Thompson,⁸ there is a "tin belt" in Western Canada, and while attempts to find and produce tin so far have been unsuccessful, except for the byproduct tin from the Sullivan ore, there seems to be enough evidence on hand to indicate that commercial tin deposits may exist and that a thorough search for them is fully justified. Imports of pig tin, which have been greatly curtailed during the past 2 years, amounted to only 1,197 tons in 1944 and 1,175 in 1943. The iron and steel industry (for making tin plate) has been the principal consumer of pig tin. A modern strip mill for the production of sheets and tin plate is to be built by the Steel Co. of Canada, Ltd. The company already has completed a tin-plate plant and a 110-inch plate mill. These additions, with those of other producers of tin plate, probably will be adequate for all of the internal requirements of Canada after the war. Before the war Canada imported about 80,000 tons of tin plate annually, mostly from the United Kingdom and the United States.

China.—Mine production has dropped steadily for about 10 years and probably was less than 3,000 tons (tin content) in 1944. Labor, fuel, and mining supplies were already critically short when the Burma road was closed in 1942. Since then internal economic conditions have rapidly grown worse, and inflation is virtually uncontrolled. According to the Metal Bulletin (London) of August 8, 1944, the price of tin was the equivalent of C\$15,000 a ton or about C\$7 a pound. The daily press early in 1944 reported the exchange rate to be about C\$200 to the United States dollar. Under such circumstances and notwithstanding completion of the Ledo road link to India and re-opening of the Burma (Stilwell) road about the beginning of 1945, little expansion in tin mining is to be expected soon because of the necessary concentration on the movement of military supplies.

Smelter output was reported by the National Resources Commission to have been only 2,195 metric tons. The largest smelter, that at Kokiu in Yunnan Province, was said to have ceased operation. The PKMA plant at Papu in Kwangsi was probably inoperative because the Japanese were in control of Hunan, Kwangsi, and Kiangsi Provinces, the sources of its ore supplies.

The United States had acquired 7,650 tons of tin in China in 1944, and a large part was flown out to India. Part of that arriving in India was diverted to other destinations, some remained in storage, some was lost in transit, and some was lost to the Japanese when they captured the United States air base at Kweilin. Tin imports from China via Calcutta were 3,338 tons in 1944. In addition to exports

⁸ Warren, H. V., Thompson, R. M., Tin in Western Canada: Western Miner, vol. 17, No. 8, August 1944, pp. 40-46.

to the United States, 170 tons went to Russia in 1944 and 4,040 in 1943.

France.—It has been reported that 2,000 tons of tin have been included in the French emergency program of nonmilitary purchases. Before the war consumption of tin in France averaged 9,100 tons annually.

Germany.—Where tin was absolutely essential for the production of war machines Germany appears to have had enough, although there was some indication late in 1944 that the supply situation had become almost desperate. Tin-plate production virtually ceased, and the canning industry depended almost entirely on black, bonderized, or otherwise chemically treated plate. Germany continued to collect scrap, although on a much smaller scale than a year or two earlier, partly because supplies in occupied Europe were exhausted and also because retreating armies cannot recover battlefield scrap. However, a large stock of bells was found by Allied forces, and it is believed there remained at the end of the war sizable quantities of other alloys and tin scrap. Frantic efforts were being made by German agents in Portugal to get metallic tin to Germany in October.* Before the Portuguese Government banned tin exports, the Germans bought large consignments and obtained permission to export up to the middle of November. The liberation of France barred the overland route, and the Allied air blockade practically barred air transport.

Germany's prewar smelter-tin output was about 12,000 tons. The principal plants were the Berzelius Metallhütten at Duisburg-Wanheim, the tin-recovery plant of Th. Goldschmidt at Essen, Norddeutsche Affinerie at Hamburg and Tempelhof A. Meyer at Berlin. All these cities were heavily damaged by Allied air or ground attacks, and it appears probable that the plants were damaged likewise.

Japan.—Small quantities of tin have been produced in Japan for centuries. Average annual production steadily increased from 300 tons in 1915 to 2,100 tons in 1938. Consumption usually exceeded production, and before 1938 Japan imported most of its needs from the Straits Settlements. Imports increased almost 70 percent during the 5-year period ended with 1938 and probably exceeded actual needs, so that a large portion doubtless was accumulated for strategic purposes. Consumption during 1944 has been estimated at less than 15,000 tons, so that little of the potential tin-producing capacity of the Far East was needed for Japan's own demands. It is not believed that very large quantities of tin could have been shipped to Germany during 1944, although a small tonnage was reported as cargo aboard a U-boat that surrendered. The near extinction of the Japanese merchant marine by the end of 1944 ended exploitation of the rich Asiatic tin fields.

Mexico.—The output of tin in Mexico was 317 tons in 1944—a decline of 26 percent compared with 1943. The control of the tin placers believed to occur in Santiaguillo Lake (Guatimape) and San Bartolo Lake in the State of Durango was transferred to the Comision de Fomento Minero. These two areas comprise 585 and 79 square kilometers, respectively, and are close to the railroad that runs between Durango and Tepehuanes, 100 kilometers north of Durango. Plans by private mining organizations to operate dredges for recovering placer tin from the lakes have been rumored.

*Tin, Flying Tin to Germany: November 1944, p. 12.

Netherlands.—One of the largest and most modern tin smelters in the world before the war was at Arnhem. The smelter was built on a small scale in 1928 and expanded continuously in size up to 1938, when its annual capacity was reported to have been 30,000 tons of refined tin. The tin concentrates treated for the most part were from Netherlands East Indies and Bolivia. Operations were curtailed sharply in 1939 when the Allied blockade interrupted imports; the plant fell into German hands in May 1940. There was no news regarding operations during the German occupation, but it is now learned that the plant probably was destroyed before Arnhem was reoccupied by Allied forces. Until possible rebuilding or resumption of operations if supplies of concentrates are available it has been presumed they may be shipped to the Texas City tin smelter for treatment.

Netherlands East Indies.—The only possible source of tin produced in the Netherlands East Indies in 1944 would have been scant output of native laborers using primitive methods. On Billiton, Banka, and Singkep there were probably 25 bucket dredges of different sizes and capacities and 5 hydraulic dredges (on Billiton and Banka), which were probably destroyed or seriously damaged before the Japanese occupied the islands. At the time of the Japanese invasion about 60 open pits and 1 underground mine were working, in addition to small operations on deposits of limited size. The tin mines of Banka were owned and operated by the Government under the management division of the Government Bureau of Mines at Bandoeng, Java. On Billiton and Singkep the Billiton Maatschappij (Co.) operated the mines jointly with the Netherlands East Indies Government. The ores from Billiton and Singkep and a small part from Banka were formerly shipped to Arnhem, Netherlands. After the invasion of Holland the ore produced in Billiton and Singkep was sent either to Singapore or to the United States. Formerly only a small part of Banka's concentrate was shipped, as the greater portion was treated in local smelters at Pangkal Balem, Muntok, and Belinjo.¹⁰

Nigeria.—It is likely that in 1944 Nigerian production declined slightly from the 1943 level, despite inducements by the Government to maintain maximum output. Operations were affected adversely by labor shortages, unfavorable weather, inadequate development, and delay in obtaining machinery. The compulsory labor program of recruiting from all parts of Nigeria proved unsatisfactory, and by the spring of 1944 all conscript labor had returned home.

The Ministry of Supply has provided for compensation for the uneconomical working of properties in order to obtain a maximum supply of tin. The Nigerian Mining Association accepted an offer from the Ministry of Supply to purchase all tin concentrates of 70-percent metal or better from all producers not already under direct contracts. The terms of purchase are retroactive to December 9, 1941, and are effective to termination of the war; cancellation is permitted either party on 6 months' notice or on resumption of official tin quotations on the London Metal Exchange. Payment for additional expenses incurred by producers in increasing their output is provided for.

¹⁰ An excellent résumé of the geology and mining practice in Netherlands East Indies was published in 1944 by the Netherlands and Netherlands East Indies Council of the Institute of Pacific Relations, Rockefeller Plaza, New York. The author, Alex L. Ter Braake, is general manager of the Tin Processing Co. smelter at Texas City, Tex.

The Tenti dam was not completed as originally designed. After negotiations with the Ministry of Supply the Nigerian Electricity Supply Corp., Ltd., took over the dam as it then stood and carried out some work to impound about two-thirds of the original amount of water contemplated.

Portugal.—Tin production in Portugal declined sharply in 1944 to 1,772 tons or about half the quantity produced in 1943. Operations were confined to a few mines operating on a very small scale at the close of 1944. Under laws and regulations in force during the past several years, all tin metal produced has been acquired on a monopoly basis by the Comision Reguladora do Comercio de Metais. No cassiterite as such was acquired, as Government purchases were confined to metallic tin only. The price paid producers was fixed at £1,350 per metric ton of metal, with a minimum of 99.50 percent tin. This Government agency also handled all local and export sales of metallic tin. The high price offered producers resulted in a boom among small mining and smelting operations. The high price paid by the Government for tin, plus selling expenses, and an export duty made prices unattractive to foreign consumers, consequently buying fell, stocks increased, and when communications with Germany were cut off in June 1944, following the Allied invasion of Europe, both Allied and German buying ceased. The Government was left with a relatively large stock of tin and has refused to buy any more or to allow it to be sold elsewhere or exported except from its stock at its price. Owing to this mining, virtually came to a standstill. The Portuguese-American Tin Co. and one or two other mines, however, continued working on a reduced scale by storing their product pending authority to dispose of it. Another factor contributing to the decline in output of tin was mining of low-grade tungsten, which fell to a very low level in 1944. Previously the mining of tungsten had been greatly stimulated by fantastic preclusive buying prices, but as this ceased in 1944 production of low-grade ores fell to a very low figure, and the byproduct tin output was affected proportionally. Spanish consumers are believed to have continued buying Portuguese tin at high prices, as they could get supplies from no other source. Some tin was purchased by Germany and flown out to Barcelona where it was transhipped by plane to Germany.

Spain.—Spain is not an important source of tin. Production has been supplemented by imports in order to meet requirements during recent years. Most of the tin produced in 1944 was from Murcia Province, where low-grade ores were mined with Government support. Tin extracted in connection with tungsten mining declined sharply during the latter half of 1944 as the closing of communications with Germany reduced the effective demand from that source. Although four plants were capable of refining tin, the small quantity of tin concentrates available was treated at the smelter of Industrias Reunidas Minero Metalurgica, S. A., Bilbao. Several small detinning plants were in operation at Huelva, Bilbao, and Barcelona. The price of metallic tin has been officially fixed at 47.50 pesos per kilo regardless of whether it is obtained from ore or detinning. The consumption of tin is Government-controlled.

Union of South Africa.—It has been estimated that the Zaaiplaats smelter produced about 1,250 tons of tin in 1944. The ores treated were derived from Central and South African sources where tin

mining was reported to have been very active. The smelting plant operated on a greatly increased scale as considerable quantities of concentrates were smelted on behalf of the National Supplies Control Board since October 1943. The Zaaiplaats Tin Mining Co. milled 44,270 tons of ore (41,420 in previous year) and recovered 188.5 long tons of concentrates (192.5 in previous year) during the year ended July 31, 1944.

United Kingdom.—With consumption cut approximately in half on a restricted basis, there was no lack of tin supplies for officially approved requirements of the United Kingdom during 1944. The principal use of tin in the United Kingdom during 1944 was for making tin plate and alloys mostly bronzes. Consumption by the tin plate mills probably increased slightly, but this was offset by reductions in the alloy field. Tin ores imported from Nigeria and Bolivia were less than in 1943; consequently, smelting operations were on a proportionally reduced scale in 1944. One smelter was reported closed as a result of wartime shortages of raw material to treat.

Mining in Cornwall was hampered by shortages of skilled underground labor and lower-grade ore. Production has been estimated as 1,100 tons in 1944. Measures are being taken to introduce a greater degree of mechanization into the underground operations. Cornwall producers have been receiving a guaranteed profit per ton of tin produced, but the price paid by the Ministry of Supply has not been disclosed. As a result of poor development and declining production the ore purchasing contract with East Pool and Agar, Ltd., has been suspended. The South Crofty mine was reported to have been taken over by the Ministry in December 1941,¹¹ and at East Pool and other operations the Government has been giving financial assistance. Exclusive of reexports and shipments from Government-owned stocks to forces abroad, exports of English refined tin were 3,144 tons in 1944 (12,251 in 1943). The sharp drop suggests a marked decline in Russian requirements. According to a statement by the Commissariat of Foreign Trade in Moscow, 29,400 tons of tin had been delivered to Russia by Great Britain since the beginning of the Russo-German War up to April 1944.

Tin-plate production in Wales was slightly higher than in 1943. The number of mills operating was virtually unchanged, but the average output per mill increased. Approximately one-third of the output is derived from the hot-strip process and the remainder from old-type cold-reduction plants. The redundancy scheme of the tin-plate manufacturers for reorganization and modernization of the industry has been accepted by the Board of Trade. The five principal firms concerned—Richard-Thomas/Baldwin combine; Guest, Keen, & Nettlefolds, Ltd.; the Briton Ferry Iron & Steel Co.; and the Llanelly Associated Co.—have agreed on the erection of a hot-strip mill for tin plate and sheets at Port Talbot, where the principal works of Baldwins, Ltd., and the Briton Ferry Steel Co., Ltd., are situated. Consideration also is being given to the establishment of cold-reduction plants at Llanelly and in one or two other districts. The Richard-Thomas/Baldwin combine referred to is the result of a merger during the latter part of December 1944 of the two largest sheet and tin-plate manufacturers in the United Kingdom. This new organization will thus control the major portion of the tin-plate output, and it is ex-

¹¹ *The Metal Bulletin* (London), No. 2363, Feb. 11, 1944, p. 7.

pected to be quite an important factor in postwar recovery of the tin-plate export trade of the United Kingdom. (The Welsh tin-plate industry, which ordinarily depended upon exporting 50 percent of its output, has been adversely affected by the war.) Before the merger Richard Thomas & Co., Ltd., had a continuous cold-strip mill and was reported to have ordered an electrolytic tinning unit. Official maximum selling prices of prime tin plate for the home trade have been 29s. 9d., per box, f. o. b. makers' works, and 30s. 9d., f. o. b. works' port for export. Production costs have been above the official selling price, and subsidy payments have been made to tin-plate makers from a central fund. The latest figure was reported to be 50s. per ton, and as the bulk of production averages 90 pounds per box the bonus represents approximately 2s. per box.

ARSENIC

By C. E. NIGHMAN

SUMMARY OUTLINE

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GENERAL STATEMENT

A record domestic production of white arsenic was made in 1944 with an increase of nearly one-sixth over that of 1943. The substantial rise offset an approximate drop of 40 percent in imports, compared with 1943, and thus maintained new supply near the high mark of 1943. This favorable circumstance with a 15-percent recession from the 1943 peak consumption rate brought year-end stocks to the highest point since 1940 and 170 percent above the 1943 low point.

The quoted price of white arsenic remained at 4 cents a pound throughout 1944. Prices for arsenical insecticides were held at the ceilings fixed in 1943 by Maximum Price Regulation 315. General Preference Order M-152 of May 22, 1942, which provided for allocation of arsenic, was revoked September 13, 1944, but control was simultaneously extended under General Allocation Order M-300, Schedule 46.

Salient statistics for white arsenic in the United States, 1940-44

	1940	1941	1942	1943	1944
Production..... short tons.....	24,983	32,481	28,681	31,202	36,094
Imports for consumption..... do.....	9,929	10,292	16,350	16,112	9,965
Exports..... do.....	¹ 1,639	¹ 1,616	¹ 305	¹ 1,975	¹ 2,401
Consumption..... do.....	² 31,600	40,442	42,411	51,083	43,500
Price per pound, end of year.....	\$0.035	\$0.04	\$0.04	\$0.04	\$0.04

¹ Exports by producers only.

² Apparent consumption.

DOMESTIC PRODUCTION

White-arsenic output in the United States in 1944 was 15 percent greater than in 1943 and exceeded the peak established in 1941 by 11 percent. As usual, byproduct output from copper and lead ore smelting was the principal source, but this was materially augmented by reduction of high-arsenic ores from the Gold Hill, Utah, area; by recovery from flue dust of the Gatchell Gold Mine, Potosi district,

Nevada, and from gold-tungsten ores of the Jardine Mining Co., Jardine, Mont. The Gold Hill ores have an arsenic content of about 18 to 30 percent and a small quantity of gold; Getchell Mine gold ores have a variable arsenic content that must be driven off by roasting before the gold can be recovered by cyanidation. At Jardine, arsenopyrite is widely distributed in the gold-lode system. The maximum white-arsenic output occurred in 1925-26, when massive arsenopyrite was mined in some sections of the property. Production was discontinued in 1936 but was resumed in 1944 after rehabilitation of the mill and arsenic plant. It has been reported¹ that recent mine production has an arsenic (As_2O_3) content of about 3 percent, although results obtained in the first half of 1944 indicate a lower tenor. Additional arsenic and arsenic compounds were derived from treatment of Canadian nickel-cobalt speiss and from speiss from the widely known Bawdwin, Burma, lead-zinc-silver mine. This material had been imported after the outbreak of the war in the Pacific.

Producers of arsenic included the American Smelting & Refining Co., Anaconda Copper Mining Co., Ferro-Enamel Corp. and Ferro Enamel Supply Co. (calcium arsenate), Jardine Mining Co., Shepherd Chemical Co. (sodium arsenite), and the United States Smelting, Refining & Mining Co.

White arsenic produced and sold by producers in the United States, 1940-44

Year	Crude			Refined			Total		
	Production (short tons) ¹	Sales		Production (short tons)	Sales		Production (short tons)	Sales	
		Short tons	Value ²		Short tons	Value ²		Short tons	Value ²
1940.....	18,241	16,688	\$365,700	6,742	6,651	\$195,600	24,983	23,339	\$561,300
1941.....	26,843	28,661	844,793	5,638	6,123	274,527	32,481	34,784	1,119,320
1942.....	25,658	27,981	1,198,424	3,023	3,057	161,942	28,681	31,038	1,360,366
1943.....	26,269	27,588	1,251,790	4,933	4,835	267,916	31,202	32,423	1,519,706
1944.....	31,182	29,159	1,370,602	4,912	5,313	326,217	36,094	34,472	1,696,819

¹ Excludes crude consumed in making refined.

² Compounds made directly from ores, flue dust, and speiss contained white arsenic as follows: 1942, 290 tons; 1943, 172 tons.

³ Partly estimated.

POSTWAR OUTLOOK

No substantial deviation from the use pattern developed in the past quarter century is anticipated. Roughly, three-quarters of the consumption of white arsenic has been for the preparation of agricultural insecticides used mainly to combat the cotton boll weevil, the codling and gypsy moths that cause widespread damage to apples and pears, and as herbicides. Of the remainder, the glass industry is the largest user and may account for 5 to 10 percent of total use. Adequate data are not available, but in the 20-year period 1920-39 consumption has apparently grown more than 50 percent, whereas the production of cotton and the fruits named has shown a substantially lower rate of change. A part of the greater rate of use may

¹ The history, economic and structural geology, and output of the Jardine Mining Co. and nearby districts have been described in a monograph by Dr. George A. Seager, *Gold, Arsenic, and Tungsten Deposits of the Jardine-Crevasse Mountain District, Park County, Mont.*: Montana School of Mines, Butte, Mont., Memoir 23, December 1944.

be attributable to a decline in price within the period, but quoted prices for white arsenic and calcium arsenate have been relatively stable near current prices since about 1925, and that of lead arsenate reasonably so for about the last 5 years of the period. Prices appear to have stabilized. No equally satisfactory and low-cost substitutes have been marketed commercially. Domestic production of the basic material, white arsenic, has kept pace with consumption. However, at no time has the domestic output been adequate to meet domestic requirements, and the United States will probably continue to be a substantial importer.

For the immediate future, a good market for all the probable domestic output of arsenic at or near the current price level seems assured, especially as world needs for foods and fibers will be at a high level. For the longer term the factors affecting domestic production are less favorable. The major one of price will be determined by the cost of imported arsenic and its relation to the cost of the byproduct material obtained principally in copper and lead smelting. After Atlantic shipping becomes available, prices cannot be expected to rise substantially because of the huge stocks of arsenic that have accumulated in Sweden as a byproduct from the treatment of the Boliden copper-gold-silver ores; these stocks are equivalent to several year's world requirements. The wartime development of effective new organic insecticides, such as DDT (dichloro-diphenyl-trichloro-ethane), may be strong competitors of arsenicals, although not yet sanctioned for commercial use. A downward trend in cotton price usually tends to contract acreage sown and correspondingly affects use of calcium arsenate. It is to be expected that a cotton price recession will follow withdrawal of wartime support or premiums and may be accentuated by competition from synthetic fibers. Exports of white arsenic and the agricultural arsenicals, measured in terms of arsenic, are much smaller than arsenic imports and therefore have no bearing on domestic production. Little change is expected in minor-use fields, and no important new applications have been described. On the whole, it appears that only low-cost or otherwise favorably situated domestic producers may retain their nearby competitive position into the more distant future.

FOREIGN TRADE²

Up to 1901 the United States was entirely dependent on foreign sources for its arsenic needs. Domestic production began in that year, but despite its rapid growth imports increased substantially, especially after the First World War, and reached a peak of 19,256 short tons in 1937, then declined to about the 10,000-ton level in 1940-41. In response to war-created demand, imports advanced to over 16,000 tons in 1942-43, but again declined to 9,965 in 1944. Since 1923, the first year in which the imports of white arsenic were clearly defined, Mexico with one exception (1923) has been the dominant supplier and in 1944 furnished 77 percent of the foreign supply, with virtually all the remainder from Peru, which appeared first as a source in 1943 with 103 tons.

² Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Exports of white arsenic were 22 percent above those of 1943 but were one-quarter under the 1939 peak. The United Kingdom was the destination of nearly one-half the total, with the remainder distributed to the Union of South Africa and other countries.

*White arsenic imported for consumption in the United States, 1940-44, by countries*¹

Country	1940		1941		1942		1943 ¹		1944 ¹	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Belgium.....	15	\$1,152								
Canada.....	339	18,016	862	\$58,850	1,449	\$32,977	35	\$2,349	5	\$100
France.....	1,654	25,799								
Japan.....	224	10,307	193	10,668						
Mexico.....	7,520	393,413	9,237	528,488	14,901	859,836	15,974	870,380	7,654	424,911
Norway.....	1	187								
Peru.....							103	3,945	2,306	120,344
Sweden.....	176	4,156								
	9,929	453,030	10,292	598,006	16,350	892,813	16,112	876,674	9,965	545,355

¹ Figures for 1943 and 1944 represent arsenic trioxide (As₂O₃) content; not strictly comparable with earlier years.

Arsenicals imported into and exported from the United States, 1940-44, by classes, in pounds

Class	1940	1941	1942	1943	1944
Imports for consumption:					
White arsenic.....	19,857,310	20,583,253	32,700,351	32,224,879	19,920,608
Metallic arsenic.....	13,228	2,240	6,854	6,840	21,395
Sulfide.....	220,445	11,025			
Calcium arsenate.....	432,785	1,230,960	215	514	
Sheep dip.....	341,556	264,350	272,540	545	159,867
Paris green and london purple ¹	25,603	12,000			
Sodium arsenate.....				133,247	
Exports:					
White arsenic ²	3,278,558	3,231,536	610,206	3,950,657	4,802,932
Calcium arsenate.....	4,879,391	5,897,598	3,941,722	6,384,559	2,411,095
Lead arsenate.....	2,000,250	9,594,483	592,029	3,054,326	4,265,513
Paris green (cupric acetoarsenite).....	(*)	224,976	171,644	1,062,640	1,138,435

¹ Arsenic trioxide (As₂O₃) content; not strictly comparable with earlier years.

² According to U. S. Department of Agriculture there have been no imports of london purple since 1936.

³ 1940-42: As reported to Bureau of Mines by the producers; 1943-44: As reported by U. S. Department of Commerce.

⁴ Dealers exported an additional 1,077,244 pounds.

⁵ Not separately classified.

⁶ Figures cover July to December; not separately classified before July 1.

CONSUMPTION AND USES

In 1944, over-all domestic consumption dropped sharply about 15 percent from the 1943 record high. This resulted principally from military contract cancellations largely by the Chemical Warfare Service, which more than offset wider use in other fields.

Production of calcium arsenate, 100 percent Ca₃(AsO₄)₂, in consequence of low boll-weevil infestation was only 22,154 short tons in 1944, compared with 34,932 tons in 1943; lead arsenate (acid and basic) output was 45,352 tons in 1944, compared with 36,978 in 1943; and that of paris green was about at the 1943 rate of 1,650 tons according to the United States Department of Commerce.

In view of the early improved supply position, 3,000 tons of white arsenic were allocated to the glass industry, a fourteenfold increase over the 1943 figure; earlier war restrictions had forced the glass industry to turn to substitutes such as antimony, cerium, and sodium sulfate. The use of arsenical insecticides for protection of shade trees, nurseries, lawns, and golf courses was authorized in February 1944. The amount of arsenic used for dyestuffs dropped over 40 percent, whereas the tonnage allocated as a weed killer was nearly as much as the sum for the preceding 2 years. Although the quantity of wood given preservative treatments in 1943 was about 17 percent less than in 1942, the use of arsenicals dropped much more abruptly because of restrictions on use of arsenic. Wolman-salts (25 percent sodium arsenate) consumption was 385 short tons, compared with 654 in 1942, and zinc meta-arsenite use was only 27 tons, compared with 120 tons in the preceding year, according to the United States Forest Service. Sales of medicinal arsenicals, which are used for the treatment of syphilis, amoebic dysentery, yaws, trichomanas vaginitis, and African sleeping sickness, dropped to 20 million doses in 1944, compared with 30 million in 1943 and 33 million in 1942, according to the United States Public Health Service. The production of these drugs—neoarsphenamine, acetarsone, carbarsone, tryparsamide, arsenoxides (mapharsen, clorarsen, phenylarsine), and sulfarsphenamine—totaled 98,006 pounds in 1944, compared with 83,026 pounds in 1943, according to the War Production Board.

White arsenic consumed in the United States, 1942-44, by uses ¹

Use	1942		1943		1944	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Insecticides.....	30,351	73	29,195	57	27,050	62
Weed killer.....	4,650	11	3,243	6	7,700	18
Glass.....	1,868	4	200	1	3,000	7
Wood preservative ²	1,038	3	(³)	(³)	(³)	(³)
Dyestuffs.....	1,080	3	1,004	2	570	1
Poison bait.....	(³)	(³)	(³)	(³)	(³)	(³)
Metal and alloys.....	(³)	(³)	(³)	(³)	(³)	(³)
Other ⁴	2,533	6	17,441	34	5,180	12
Total consumption.....	41,520	100	51,083	100	43,500	100

¹ Data from War Production Board; largely based on allocations.

² Includes wallboard.

³ Included under "Other."

⁴ Gas purification, pharmaceuticals, cattle dip, paint, and other uses.

PRICES

The quoted price for white arsenic remained at 4 cents a pound throughout the year, according to the Oil, Paint and Drug Reporter. Maximum Price Regulation 315 of February 9, 1943, fixed the base price for lead arsenate in carlots at 11 to 11½ cents a pound. The ceiling base prices for other arsenical insecticides were fixed by an amendment on April 6, 1943, as follows (cents per pound in carlots): Calcium arsenate, 7 to 7½; paris green, 20 to 25; and london purple, 7 to 8.

STOCKS

The substantial cut in military requirements early in 1944 and the 37-percent decline in calcium arsenate output, while new supply was nearly equal to that in 1943, was reflected in a much improved year-end stock position over that of preceding years.

Year-end stocks of arsenic compounds in the United States, 1940-44, in short tons

Year	White arsenic			Calcium arsenate ¹ (producers)	Lead arsenate ¹ (producers)
	Producers	Government	Total		
1940.....	6,944	-----	6,944	(²)	(²)
1941.....	4,518	-----	4,518	1,786	5,108
1942.....	2,187	2,693	4,880	2,584	2,223
1943.....	1,138	1,018	2,156	4,757	4,020
1944.....	2,760	3,029	5,789	7,648	7,404

¹ Basis, 100 percent $\text{Ca}_3(\text{AsO}_4)_2$. From U. S. Department of Commerce.

² Acid and basic. From U. S. Department of Commerce.

³ Comparable data not available. Suppliers held 12,500 tons of calcium arsenate and 5,000 tons of lead arsenate at end of 1940 compared with 2,650 and 5,625 tons, respectively, at end of 1941, according to the Agricultural Insecticide and Fungicide Association.

REVIEW BY COUNTRIES

Insofar as data are currently available, world production of white arsenic in recent years is shown in the following table:

World production of white arsenic, 1936-44, by countries, in metric tons ¹

[Compiled by B. B. Waldbauer]

Country ¹	1936	1937	1938	1939	1940	1941	1942	1943	1944
Australia:									
New South Wales.....	124	-----	-----	-----	-----	-----	-----	(²)	(²)
Western Australia.....	3,526	2,087	4,063	1,439	3,385	3,432	2,771	2,320	(²)
Belgium-Luxembourg (ex-ports).....	2,731	3,039	2,706	3,332	(²)	(²)	(²)	(²)	(²)
Brazil.....	732	717	519	713	1,088	1,172	900	970	366
Canada.....	619	630	987	790	950	1,605	3,562	1,430	1,153
China.....	(²)	(²)	(²)	(²)	800	(²)	(²)	(²)	(²)
Chosen.....	230	-----	(²)	(²)	(²)	(²)	(²)	(²)	(²)
France.....	9,750	6,501	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Germany (exports).....	2,739	2,852	2,845	(²)	(²)	(²)	(²)	(²)	(²)
Greece.....	85	234	77	113	(²)	(²)	(²)	(²)	(²)
Hungary.....	-----	100	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Italy.....	-----	-----	810	1,151	(²)	1,200	(²)	(²)	(²)
Japan.....	2,629	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Mexico.....	8,527	10,762	8,894	7,063	9,268	12,844	18,520	20,301	15,306
Peru.....	-----	-----	-----	-----	-----	-----	7	385	(²)
Portugal.....	150	112	1	426	410	535	(²)	(²)	(²)
Rumania.....	-----	6	3	(²)	(²)	(²)	(²)	(²)	(²)
Southern Rhodesia.....	-----	-----	19	-----	(²)	(²)	17	(²)	(²)
Spain.....	-----	-----	11	(²)	14	94	222	239	(²)
Sweden (sales) ⁴	8,647	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
United Kingdom.....	155	97	66	(²)	(²)	(²)	(²)	(²)	(²)
United States.....	13,952	15,253	15,136	20,267	22,604	29,466	26,019	28,306	32,744
	55,700	56,000	59,000	63,000	71,000	(²)	(²)	(²)	(²)

¹ Arsenic is also believed to be produced in Czechoslovakia, Iran, Turkey, and U.S.S.R. Production figures are not available for these countries.

² Data not available; in 1936 to 1940, inclusive, estimate included in total.

³ January to June, inclusive.

⁴ August to December, inclusive.

⁵ Arsenic content of ores mined was as follows—1936: 23,312 tons; 1937: 20,954 tons; 1938: 21,480 tons. Data not available for later years.

Argentina.—Enough white arsenic has been available from Mexico to permit the industry to meet all requirements for calcium arsenate and paris green, but fruit growers are handicapped by a serious shortage of lead arsenate. Production of the latter material from mispickel ore in the Mendoza region is expected to amount to approximately 150 tons in 1944.³

Brazil.—Owing to a shortage in supplies, the Government set up controls over production and distribution of arsenic. Before the war, Belgium, Germany, Japan, and the United States were the principal suppliers; now only limited quantities (mostly in the form of insecticides) are available from the United States and the United Kingdom.

Virtually the total Brazilian arsenic production is derived from gold ores. In the first half of 1944, output, which was about 75 percent of the corresponding 1943 production, was as follows, with totals for the year 1943 in parentheses: St. John del Rey Mining Co., 314 metric tons (816), and Cia Minas de Passagem, 52 metric tons (141). The average value (5.64 cruzeiros a kilogram) in 1944 was about 8 percent above that for 1943.

Canada.—According to a preliminary estimate of the Dominion Bureau of Statistics, Canadian arsenic production in 1944 (1,272 short tons) was 81 percent of the 1943 volume, and the average value per pound declined 17 percent to about 6.7 cents. The major producers were the Beattie Gold Mines, Ltd., and the O'Brien Gold Mines, Ltd., both in the Province of Quebec. Refined arsenic was made by the first-named and by the Deloro Smelting & Refining Co., Ltd., Deloro, Ont.

Colombia.—The Instituto de Fomento Industrial planned to produce arsenic and to manufacture arsenic compounds at a plant near Samana, Department of Caldas.⁴

Great Britain.—The Long Ashton Research Station has reported outstanding results with DDT as an insecticide. It was suggested that it be given field trial as a substitute for lead arsenate.⁵

India.—India is dependent on foreign sources for its arsenic. Only very small and intermittent production from small and inaccessible deposits in northern Mysore and at Chitral in the Himalayan region has been recorded.⁶

Peru.—The Cerro de Pasco Copper Corp.'s plant, which began operation in June 1943, is estimated to have produced about 8,068 short tons of white arsenic during 1944. Although a contract with the Metals Reserve Company called for the delivery to the United States of 800 tons monthly in 1943-44, deliveries were 5,354 short tons in 1944 and 103 tons in 1943.

Sweden.—The excessive accumulations of white arsenic, believed to exceed 350,000 tons, and current production from Boliden's copper-gold-silver ore constitute a threat to other producing countries. This position is enhanced by the termination in May 1945 of the European phase of the World War, as all European requirements easily may be satisfied, thus curtailing the pressure on the United States and Mexico, the remaining important world suppliers. An invasion of Western Hemisphere markets may not follow for some time because of ship shortage and high freight rates. The Boliden Co. has en-

³ Foreign Commerce Weekly, Argentine Insecticides and Fungicides: Vol. 17, No. 9, Nov. 25, 1944, p. 24.

⁴ The Chemical Age (London), vol. 102, No. 1332, Jan. 6, 1945, p. 22.

⁵ Chemical and Engineering News, News Edition, vol. 23, No. 6, Mar. 25, 1945, p. 584.

⁶ Metal Bulletin (London), No. 2910, July 14, 1944, pp. 4-5; 10.

gaged in research work⁷ in an attempt to develop new markets. One result has been the substitution of zinc arsenate for lead arsenate. The zinc salt is reported to be more effective than the lead and to be less toxic to human beings. It may also be used as a weed killer, and it is believed that it can be applied for that purpose to a sown field without injury to crops. It has also been reported⁸ that licenses may be had for an arsenic treatment of lumber that makes it weather resistant.

U.S.S.R.—A novel method of manufacturing paris green has been reported⁹ by Soviet scientists. White arsenic is added to a boiling solution of copper oxide in acetic acid in place of the usual method of dissolving arsenic in soda lye and mixing the solution with copper sulfate and acetic acid. In the latter method the soda is lost as the sulfate in the filtrate, whereas in the proposed scheme the filtrate containing any unreacted copper and arsenic may be re-used.

The Soviet press reports that operations have begun at the recently discovered Azerbaidjan arsenic deposits.

⁷ Metal Bulletin (London), No. 2874, Mar. 3, 1944, p. 11.

⁸ Chemical Industries, Swedish Markets: Vol. 61, No. 2, February 1945, p. 244.

⁹ Chemical Industries, vol. 61, No. 2, February 1945, p. 256.

BISMUTH

By C. E. NIGHMAN

SUMMARY OUTLINE

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GENERAL STATEMENT

Domestic refinery production of bismuth rose moderately in 1944 compared with 1943 but was offset by a decline in imports of nearly the same magnitude. Total stocks in the United States at the year end were but slightly above those at the end of 1943, a position obtained only through holding consumption closely to the new supply rate. Conservation measures instituted by the War Production Board early in 1943 were effective throughout 1944, essentially unmodified. Conservation Order M-295, bismuth chemicals, was revoked January 20, 1945, but its provisions, virtually unchanged, were embodied simultaneously in Schedule 88 of General Allocation Order M-300.

FUTURE OUTLOOK

Bismuth needs of the United States had been met from foreign sources until 1906 when domestic recovery began. Subsequently, and even through the several depressions, the metal and salts as well continued to be received from abroad. Domestic output, though increasing, did not overtake expanding requirements. These general trends are expected to continue, with the result that all economic domestic production should be absorbed readily.

Changes in the use pattern indicate wider markets. In the early 1930's consumption was of the order of one-third million pounds, and probably not over one-quarter was used for other than medicinals or cosmetics. About that time low-melting-point alloys—approximately one-half bismuth—began to find new uses, such as a filling or backing in the bending of thin-walled tubing and other light sections; these fillings are recovered by heating the formed material to the very low melting point of the bismuth alloy. By 1941 consumption had probably exceeded 1¼ million pounds, and the nonmedicinal-cosmetic application share had risen to about 40 percent. The needs for the alloys were so large that the War Production Board was forced from 1942 on to hold the medicinal-cosmetic percentage to about 45 percent despite peak domestic production and imports. Many of the war-

time uses, including some that are still secret, will probably persist.¹ When restrictions on the use of bismuth are lifted consumption probably will rise well above that of the immediate prewar years. Demand can be expected to taper off when industrial inventories of alloys have increased sufficiently to carry on shop operations, most of which are essentially nondissipative.

DOMESTIC PRODUCTION

The output of refined bismuth in the United States in 1944 was little more than 2 percent above that of 1943; actual production data may not be given by the Bureau of Mines. Exploration work of the Bureau of Mines in the Alta district, Utah, begun in 1943, disclosed several bismuth-bearing ore bodies containing 1 to 5 percent bismuth.

Domestic producers (smelters and refineries) were, as they have been for 10 years or more, American Smelting & Refining Co., Anaconda Copper Mining Co., and the United States Smelting, Refining & Mining Co. The metal was obtained as a byproduct in the smelting of domestic and foreign lead and copper ores, from Mexican bismuth-lead bullion, and from a small volume of South American bismuth ores. The Cerro de Pasco Copper Corp., New York, is the largest importer and consumer of bismuth.

FOREIGN TRADE²

Imports.—Bismuth-ore imports comprised 78,564 pounds (46.7 percent Bi) from Argentina, 12,901 pounds (53.2 percent Bi) from Bolivia,³ and 27,274 pounds (27.7 percent Bi) from Chile, according to the Foreign Economic Administration. Mexican output (see world-production table) is almost entirely in the form of bismuth-lead bars, which are imported into the United States for refining. All refined-metal imports, 1940–44, originated in Peru.

Bismuth imported for consumption in the United States, 1940–44

Year	Bismuth ore ¹			Refined metallic bismuth		Bismuth compounds and mixtures	
	Pounds		Value	Pounds	Value	Pounds	Value
	Gross weight	Bi content					
1940.....	(1)	(1)	(1)	123, 880	\$118, 260	4	\$31
1941.....	(1)	(1)	(1)	223, 477	223, 463	41	744
1942.....	(1)	(1)	(1)	(2)	(2)	7	22
1943.....	138, 600	48, 800	\$52, 400	430, 874	397, 676	13	53
1944.....	118, 739	51, 349	60, 878	363, 980	345, 796	40	352

¹ Figures from Foreign Economic Administration. Those for 1940–42 are not available but are believed to be negligible.

² No "imports for consumption"; general imports of 222,684 pounds were reexported.

³ An additional 71,236 pounds (valued at \$43,498) reported by the U. S. Department of Commerce as "bismuth" is ore and is covered by that category in this table.

¹ Trethaway, J. D., *Bismuth Alloys: Metals and Alloys*, vol. 21, No. 1, January 1945, p. 93.

² Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

³ Preliminary figures.

Bismuth exported from the United States, 1942-44, by classes

Class	1942		1943		1944	
	Pounds	Value	Pounds	Value	Pounds	Value
Mette.....	11,495	\$6,387	10	\$20	46	\$74
Metal and alloys.....	14,827	10,254	16,209	10,745	10,161	8,557
Compounds and mixtures:						
Carbonate.....	70,356	91,674	25,795	42,055	46,446	67,281
Chloride.....	317	832	2,438	6,967	501	1,473
Gallate.....	19,012	28,748	7,278	11,515	8,429	13,302
Iodide.....	1,002	1,965	551	1,484	2,884	1,432
Nitrate.....	146,769	98,812	33,259	45,279	41,030	54,198
Oxide.....	450	1,701	345	1,226	355	1,154
Saccharate.....	2	4				
Sulfate.....	30	45			2	20
Other.....	25,129	36,651	6,412	13,609	11,299	26,482

CONSUMPTION AND USES

Domestic consumption was reduced nearly 27 percent from the 1943 level to hold use close to new supply and thus maintain the Government-owned stock pile near the desired level.

The wartime importance of metallurgical applications and limited supply brought about striking changes in distribution. Pharmaceutical and cosmetic uses accounted for 40 percent of the bismuth consumed and metallurgical use for most of the remainder, the converse of the 1941 relationship. Most commercial bismuth alloys have low melting points and tend to expand on solidification. These properties make them especially useful as a support for thin-walled tubing to prevent wrinkles or collapse while being formed; to hold parts in dies or machine tools; for the chucking of irregularly shaped pieces; for nitriding furnace seals; as fusible plugs in fire protective devices; as short-run forming dies; and in ammunition and substitute solders. New uses are electroforming of intricately shaped parts to close tolerances and as a sprayed coating on patterns and core boxes to give smooth surface finish and sharp contour reproduction. Additions of small quantities of bismuth or bismuth-lead to aluminum alloys, stainless, manganese, and carbon steels, and some other alloys have shown marked increases in machinability.⁴ Bismuth pharmaceutical products are used principally as antisypilitics but also in indigestion remedies and in cosmetic powders.

Bismuth consumed in the United States, 1942-44, by uses

Use	1942 ¹ (per- cent of total)	1943 ²		1944 ³	
		Pounds	Percent of total	Pounds	Percent of total
Pharmaceuticals: Medicines and cosmetics.....	45	985,544	49	585,193	40
Manufacturing alloys.....	15	652,558	33	420,894	29
Solders and bearings.....	31	237,212	12	211,789	14
Miscellaneous.....	9	129,077	6	241,764	17
Total consumption.....	100	2,004,391	100	1,465,640	100

¹ Estimated from producers' and importers' shipments.

² From War Production Board.

³ Includes 208,632 pounds in ammunition solders in 1943 and 211,789 pounds in 1944; most of remainder in tin-savng solders.

⁴ Includes 40,889 pounds in fuse alloys and 31,912 pounds in rectifier coatings in 1943 and 91,096 and 72,192 pounds, respectively, in 1944.

⁵ Trethaway, J. D., Work cited in footnote 1.

STOCKS

Producers', distributors', and consumers' bismuth inventories at the year end were less than 3 percent larger than at the beginning of the year; Government-owned Metals Reserve Company metal stocks increased.

PRICES

Metallic bismuth continued to be quoted throughout 1944 at \$1.25 per pound, ton lots, according to E&MJ Metal and Mineral Markets. Base prices of bismuth compounds, likewise unchanged, were listed by Oil, Paint and Drug Reporter as follows, per pound:

Chloride.....	\$2. 85	Oxychloride.....	\$3. 10	Subnitrate.....	\$1. 20
Citrate.....	2. 75	Subbenzoate.....	3. 40	Subsalicylate.....	2. 50
Citrate, ammonia..	3. 40	Subcarbonate.....	1. 50	Sulfocarbolate.....	3. 65
Hydroxide.....	3. 35	Subgallate.....	1. 40		
Nitrate.....	1. 30	Subiodide.....	4. 13		

WORLD REVIEW

Estimated world production in 1944 was about 1,200,000 kilograms (2,640,000 pounds). The major producers were the United States, Peru, Canada, and Mexico.

*World production of bismuth, 1939-44, by countries, in kilograms*¹

[Compiled by B. B. Waldbauer]

Country ¹	1939	1940	1941	1942	1943	1944
Argentina.....	2,860	4,880	10,040	13,101	20,900	(²)
Australia (in ore) ..	2,200	2,800	2,200	4,800	6,800	(²)
Bolivia (in ore and bullion exported) ..	12,653	18,700	22,604	8,896	12,419	605
Canada: Metal.....	185,722	18,479	6	156,605	184,882	56,154
In bullion.....	(³)	8,069	3,401	1,043	(³)	(³)
France (metal).....	(⁴)	3,000	30,000	10,000	(⁴)	(⁴)
Mexico (in impure bars).....	163,683	185,433	97,971	128,041	175,055	165,379
Peru: Metal.....	402,027	387,479	276,907	373,942	482,916	416,159
In lead-bismuth alloy.....	52,430	56,314	178,138	16,913	15,198	(⁵)
Spain (metal).....	(⁶)	10,878	3,900	15,880	15,198	(⁶)
Union of South Africa (in ore).....	1,379	(⁷)	332	167	1,815	1,635
United States.....	(⁷)	(⁷)	(⁷)	(⁷)	(⁷)	(⁷)
World production (estimate).....	1,300,000	1,400,000	1,400,000	1,700,000	1,400,000	1,200,000

¹ Bismuth is believed to be produced also in Brazil, Burma, China, Germany, Japan, Norway, Rumania, Sweden, Uganda, U. S. S. R., United Kingdom, and Yugoslavia. Production figures are not available for these countries, but estimates by author are included in total.

² In ore.

³ Content of ore exported to United States.

⁴ Data not available. Estimate included in total.

⁵ Partly estimated. Excludes content of some bismuth-tungsten concentrates.

⁶ Excludes bismuth content of tin concentrates exported.

⁷ Production included in total; Bureau of Mines not at liberty to publish figure.

Canada.—In 1944 the total Canadian production was derived from treatment of lead-silver ores by the Consolidated Mining & Smelting Co., Ltd., at Trail, B. C. Most of the 70-percent drop in output in 1944 was attributable to exhaustion of residues accumulated before 1942 and in part to a 30-percent decrease in lead production in 1944.

Peru.—The statement concerning primary sources of bismuth reported in the Bismuth chapter of Minerals Yearbook, 1943, was in error in attributing 80 percent of the production to lead or lead-silver mines. Bismuth is present in very small quantities in a great many of the copper and lead ores treated by the Cerro de Pasco Copper Corp. Dusts collected at its copper and lead smelters are treated in

the bismuth refinery that has a daily capacity of 4,000 pounds refined (99.99 percent Bi) bismuth. Exports of refined bismuth in 1944 were 446 metric tons, of which about 180 tons were destined to the United States and the remainder to the United Kingdom.

Spain.—No production was reported in the Civil War period, 1936–39, but from 1940–44 concentrate output (about 25 percent Bi) ranged from about 40 to 50 metric tons annually, except in 1942 when it rose to about 125 tons. In this period metal output averaged a little over 10 tons a year, which was about in equilibrium with Spain's domestic requirements. The principal source of bismuth is in Córdoba Province. In 1942 the price of metal had been fixed at 50 pesetas a kilogram, but it was raised to 90 pesetas about the end of 1943 in order to stimulate mining.⁵

United Kingdom.—Demand for bismuth and alloys for metallurgical use remained strong throughout the year. The price was unchanged at 6s. 3d. a pound in 5-cwt. lots in 1944.

⁵Metal Bulletin (London) Bismuth: No. 2863, Jan. 25, 1944, p. 11.

MAGNESIUM

By JOHN G. WEITZ AND MARY E. TROUGHT

SUMMARY OUTLINE

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SUMMARY

Production of primary magnesium in the United States in 1944 totaled 157,100 short tons—14 percent less than in 1943 (183,584 tons). Owing to decreased war requirements and growing stocks, production was cut back 83 percent in several stages between March and December 1944.

Salient statistics of the magnesium industry in the United States, 1940-44

	1940	1941	1942	1943	1944
Production of primary magnesium ¹ short tons..	6,261	16,295	48,963	183,584	157,100
Quoted price per pound ² cents..	27.0	22.5	22.5	20.5	20.5
Exports.....short tons..	859	³ 1,549	³ 4,045	35,631	21,001
World production (estimated).....do....	49,500	85,500	141,600	297,400	259,700

¹ Ingot equivalent.

² Lowest nominal price (New York) for primary metal ingot 99.8 percent pure, carlots.

³ Magnesium metal in primary form.

Magnesium sold or used during the year totaled 146,585 tons, 14 percent less than the 1943 figure of 170,267 tons. Actual consumption of magnesium in the form of primary metal and alloy (excluding secondary) was 132,698 tons (magnesium content). Exports in the form of metal totaled 21,001 tons; imports were negligible.

In October 1944 all restrictions on the use of magnesium were removed by the War Production Board.

World magnesium output is estimated at 235,100 metric tons in 1944, 13 percent less than the record production of 1943. Axis and Axis-dominated countries controlled about 29 percent of the world total, whereas the United Nations furnished 71 percent, according to estimates.

PRODUCTION

Raw materials.—Magnesium, the lightest and newest of the industrial metals, is produced from a wide variety of sources. Sea water,

dolomite, magnesite, underground brines, and residues from potash manufacture were the raw materials used commercially in the United States in 1944.

Sea water was used as a primary raw material in two Texas electrolytic plants and in conjunction with dolomite at a California carbo-thermic process plant. Dolomite alone was used at six ferrosilicon-process plants in Connecticut, New York, Ohio, Michigan, Washington, and California; dolomite with calcium chloride waste liquors was used at an electrolytic plant in Ohio and one in Louisiana; and dolomite and byproducts of potash manufacture were used at Carlsbad, N. Mex., to produce magnesium chloride for an electrolytic plant in Texas. In Nevada a large deposit of magnesite was mined for use in a large Magnesium Elektron electrolytic process plant in Las Vegas. Two plants in Michigan used well brines containing magnesium chloride in electrolytic cells for the production of magnesium.

Primary magnesium.—Production of primary magnesium in the United States in 1944 totaled 157,100 short tons (ingot equivalent), a decrease of 14 percent from the 183,584 tons produced in 1943. These figures represent the ingot produced directly from Dow-type electrolytic cells plus a magnesium "ingot equivalent" of the raw and crystal metal obtained from other processes of manufacture which experiences some loss when melted down into ingot form. The total output of all primary magnesium in the various forms, making no allowance for melting losses, was 161,935 tons in 1944 compared with 190,025 tons in 1943. A quantity of microscopic magnesium dust produced during 1944 was not included in the production figures because it is made directly into an incendiary mixture ("goop") and does not actually enter the market as magnesium metal.

At the beginning of 1944 surplus stocks of magnesium ingot had risen to about 24,000 short tons. A recommendation was made by the War Production Board to accumulate a reserve equivalent to about 2 months actual requirements to be held at Government-owned plants. In view of this recommendation and the fact that stated requirements remained high, no substantial cut backs in production were made until March. The annual rate of output in the first quarter of the year averaged nearly 248,000 tons, or about 85 percent of the country's rated capacity.

The initial cut-back in the magnesium-producing industry was effected on February 1 with a 33-percent curtailment at the ferrosilicon-process plant of the Defense Plant Corporation (DPC), operated by Amco Magnesium Corp. at Wingdale, N. Y. The cut-back amounted to only 1,650 tons a year or less than 1 percent. Later, as output of new metal threatened far to outstrip consumption plus planned stock-pile accumulations, further cut-backs were ordered. On March 1 cut-backs were made at three more ferrosilicon-process plants, totaling 37,000 tons of annual capacity, distributed as follows: Ford Motor Co. DPC plant, Dearborn, Mich., 20,000 tons or 100 percent; Electro Metallurgical Corp. DPC plant, Spokane, Wash., 12,000 tons or 50 percent; and Permanente Metals Corp. DPC plant, Manteca, Calif., 50 percent or 5,000 tons. On April 1 the Mathieson Alkali Works, Inc. DPC electrolytic plant, Lake Charles, La., was closed, representing a 27,000-ton cut-back, and the Basic Magnesium, Inc., DPC M. E. L. process plant at Las Vegas, Nev., was cut 40

percent or 22,400 tons. Dow Magnesium Corp. was ordered to curtail output 40 percent or 14,400 tons a year at its DPC plant, Marysville, Mich., on May 1, and on June 1 orders were given to close the Permanente Metals Corp. Manteca plant and the Amco Magnesium Corp. Wingdale plant, representing 8,350 tons of capacity. On July 25 the remaining 21,600 tons capacity of Dow Magnesium Corp. at Marysville was closed; an additional 20 percent or 11,200 tons at the Basic Magnesium Las Vegas Plant and 16 percent more or 4,000 tons at the Electro Metallurgical Corp. plant were closed. During August production dropped below an annual rate of 150,000 tons for the first time since February 1943, the growth of surplus stocks had been slowed, and

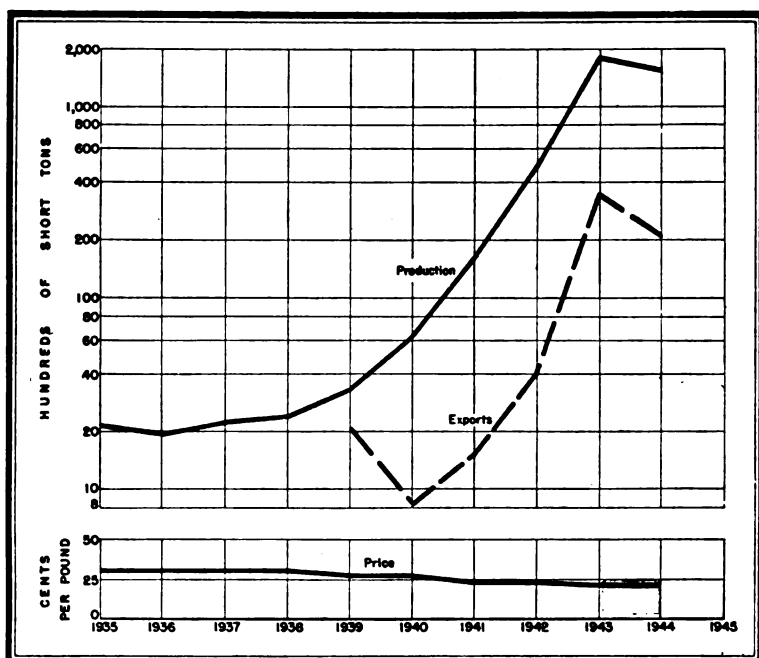


FIGURE 1.—Trends in production, exports, and quoted price of primary magnesium, 1935-44.

ingot stocks at military facilities had been greatly reduced. However, requirements of magnesium were cut still further in late summer, and on August 31 the remaining 40 percent of capacity (22,400 tons) was closed at the Las Vegas plant of Basic Magnesium, Inc.; the International Mineral & Chemical Corp. DPC plant, Austin, Tex., was closed (12,000 tons); and the Dow Magnesium Co. DPC plant, Velasco, Tex., was curtailed 50 percent or 18,000 tons. Thus, by September 1, 200,000 tons of an annual capacity of 293,000 tons had been cut by Government order. On September 25 Diamond Magnesium Co. was ordered to curtail output at its DPC plant, Painesville, Ohio, by 25 percent or 4,500 tons; and on October 15 a 60-percent cut or 3,000 tons was announced for New England Lime Co. at Canaan, Conn. The final cut-backs of the year came on November 25, closing the Dow Magnesium Corp. plant at Marysville (18,000 tons or 50 percent), effecting another 25-percent cut at the Diamond

Magnesium Corp. plant (4,500 tons), and reducing output 40 percent at the Magnesium Reduction Co. DPC plant, Luckey, Ohio (2,000 tons). By January 1, 1945, the War Production Board had ordered the closing of 232,000 tons or 79 percent of total domestic capacity. Voluntary reductions at privately owned plants added to the War Production Board cut-backs were such that in December the entire industry operated at an annual rate of about 17.4 percent of total rated capacity.

Of all the primary magnesium plants closed during 1944 only two—the Ford Motor Co. plant at Dearborn, Mich., and the Mathieson Alkali Works, Inc., plant at Lake Charles, La.—were not held in stand-by condition. However, part of the Electro Metallurgical Co. plant at Spokane, Wash., has been converted to the production of metallic sodium. The Basic Magnesium, Inc., plant at Las Vegas, Nev., has also been partly converted; the Western Electrochemical Co. installed equipment in cell unit 4 for the production of potassium perchlorate, and the Rheem Mfg. Co. took over part of the plant to produce 81-mm. mortar shells and rocket projectiles for the Army and Navy. New England Lime Co., Canaan, Conn., is using part of its plant for the production of metallic calcium.

Production, sales, exports, and apparent consumption of primary magnesium in the United States, 1940-44, in short tons

	Production		Sales	Exports	Apparent consumption ¹
	Raw, crude, and pure ingot	Ingotequivalent			
1940.....	6,261	6,261	6,411	² 834	5,577
1941.....	16,295	16,295	15,528	1,549	13,979
1942.....	³	48,963	47,420	4,045	43,375
1943.....	190,025	183,584	170,267	⁴ 14,720	155,547
1944.....	161,935	⁵ 157,100	146,585	⁶ 4,830	141,755

¹ Does not consider fluctuations in consumers' stocks and metal derived from scrap. Withdrawals from producers' stocks totaled 150 tons in 1940; additions to producers' stocks totaled 767 tons in 1941; 1,643 tons in 1942; 13,317 tons in 1943; and 10,615 tons in 1944.

² Of the 859 tons of metal exported, 25 tons consisted of magnesium alloy.

³ Not available.

⁴ Of the 35,631 tons of metal exported, 20,911 tons consisted of magnesium alloy.

⁵ Does not include magnesium content of incendiary mixture produced direct.

⁶ Approximately 77 percent of the 21,001 tons exported was magnesium alloy.

Secondary magnesium.—Recovery of secondary magnesium totaled 14,185 short tons (including secondary magnesium incorporated in primary magnesium ingot) in 1944 (11,404 tons in 1943) and required the consumption of 17,014 tons of magnesium scrap, which was almost entirely new scrap. Of the quantity of magnesium recovered, 13,379 tons were as ingot, 235 went into castings, 23 into aluminum alloys, 7 into lead and zinc alloys, and 541 into chemicals and incendiary products. Additional information on secondary magnesium will be found in the chapter on Secondary Metals—Nonferrous.

CONSUMPTION

Virtually all the magnesium consumed during 1944 went into military uses, even though restrictions on its use for civilian items were revoked in October. The most important end uses of the metal were

incendiary bomb casings and aircraft engine parts, frames, landing gear, and accessories. Other important uses included rocket-launcher tubes, powder for incendiaries, flares, and tracers, and as an alloying metal with aluminum. Apparent consumption of pure primary magnesium in 1944, calculated by subtracting exports from sales, totaled 141,755 short tons compared with 155,547 tons in 1943, a decrease of 9 percent.

Consumption of primary magnesium and magnesium alloy (excluding secondary) in 1944 totaled 132,698 tons (magnesium content). No comparable figures are available for earlier years, because previous consumption surveys measured the quantities of magnesium structural and nonstructural products used. The survey of consumption conducted in 1944 measured use of primary and alloy magnesium ingot in production of the various structural and nonstructural products. Of the 132,698 tons consumed, 111,790 tons (84 percent) were used in the production of structural products (castings, sheet, structural shapes, and forgings); and 20,908 tons or 16 percent were consumed in other uses, including powder, alloys with other metals, and miscellaneous uses. Castings, including sand, die, and permanent mold types, was the largest single use for the metal, taking 105,119 tons of the total.

Actual domestic consumption of primary magnesium (ingot equivalent and magnesium content of magnesium-base alloy) in 1944, by uses

Product	Short tons	Product	Short tons
Structural products:		Other products:	
Castings:		Powder.....	9,080
Sand.....	44,773	Aluminum alloys.....	6,868
Die.....	1,165	Other alloys.....	12
Permanent mold.....	59,181	Scavenger and deoxidizer.....	150
Sheet.....	1,543	Chemical.....	156
Structural shapes, rods, tubing (extrusions).....	4,784	Other.....	4,633
Forgings.....	344	Total other products.....	20,908
Total structural.....	111,790	Grand total.....	132,698

¹ Includes primary metal consumed in making secondary alloy.

PRICES

Throughout 1944 the base price of standard four-notch magnesium ingot remained at 20.5 cents a pound under Maximum Price Regulation 314, as amended. On March 11, 1944, magnesium powder, dust, and similar material were removed from the provisions of the General Maximum Price Regulation and placed under MPR 314 by Amendment 5. A ruling permitting alloys not formerly sold in ingot form to be sold at differentials above previously established ceilings became effective on October 2, 1944, in Amendment 6 to the magnesium price regulation. All alloys had been given a ceiling price of 23 cents a pound except four specific alloys, which were given higher ceilings; this amendment expanded the listing to provide specific prices for all ASTM alloys. Also added was a provision requiring that the maximum price of any alloy not listed shall be one approved by the Office of Price Administration and after approval shall be the maximum price for all subsequent sales by the same seller unless approval is withdrawn. Sales of less than 500 pounds of all alloys not listed in the price regulation were exempted from pricing; this provision

relieves industry of applying for approval of prices for items that will not be sold commercially, although such sales must be reported to the Office of Price Administration.

FOREIGN TRADE¹

Imports in 1944 of magnesium in all forms, all of which came from Canada, totaled 120,421 pounds (60 tons) valued at \$54,966 and consisted of 54,400 pounds of metal and scrap; 1 pound classified as sheets, tubing, ribbon, and other forms; and 66,020 pounds of powder.

Exports of magnesium from the United States, 1943-44

	1943		1944	
	Short tons	Value	Short tons	Value
Magnesium metal in primary form.....	135,631	\$16,272,607	21,001	\$9,799,833
Magnesium metal in other forms.....	2,674	1,478,141	1,597	987,048
Magnesium powder.....	2,126	1,207,429	1,600	2,301,293

¹ Includes 20,911 tons of magnesium-base alloy.

² Includes 16,171 tons of magnesium-base alloy.

Exports of metal in primary form included 15,958 tons that went to the United Kingdom, 4,996 to the U. S. S. R., 40 to Mexico, 5 to Canada, 2 to Brazil, and less than 1 ton each to Chile and the Union of South Africa. Of the magnesium metal in other forms, 999 tons were destined for the United Kingdom, 444 for the U. S. S. R., 93 for Mexico, 57 for Canada, 3 for Australia, and less than 1 ton each for Uruguay, Tunisia, and the State of Bahrein. Magnesium powder exported during 1944 included 1,583 tons shipped to the United Kingdom, 13 to Canada, 3 to Australia, 1 to Sweden, and less than 1 ton each to Algeria, Brazil, Mexico, and the U. S. S. R.

In 1944 exports of magnesium metal in primary form were equivalent to about 13 percent of the total domestic production compared with 19 percent in 1943.

WAR MEASURES

On October 5, 1944, Preference Order M-2-b, restricting the use of magnesium, which had been in effect since November 14, 1941, was revoked by the War Production Board. Simultaneously the Board issued Order M-2-c, which provides that all restrictions on the use of magnesium contained in other War Production Board orders no longer apply. However, restrictions in other orders as to the quantity of an article that may be made or as to its size and type remain applicable, even if the article is made wholly of magnesium. Order M-2-c states that persons wishing to obtain magnesium or its products may place rated or unrated orders with their normal suppliers without approval of the War Production Board, although such delivery orders are subject to priority regulations.

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TECHNOLOGIC DEVELOPMENTS

Progress continued in 1944 in the field of alloying and fabricating magnesium, especially wrought alloys. A new sheet alloy, Dowmetal 251 X, having 5 percent aluminum and 1 percent zinc and being substantially tougher and more ductile than the previous sheet alloy, was announced during the year. Heat treatment for extruded alloys of the 8-percent aluminum, 0.5 percent zinc-type was developed with minimum yield strengths of 30,000 pounds per square inch in tension and compression.

During 1944 and early 1945 several publications appeared giving descriptions of processes used for producing magnesium and of laboratory investigations of other processes not used commercially. Much of the work referred to was done in the period from 1941 to 1943, but the appearance of more complete reports during 1944 warrants mention herein.

In July 1941 work was initiated at the Boulder City, Nev., Experiment Station of the Bureau of Mines² on processes that required minimum reliance on value of byproducts and could meet competition from present processes by using low-grade magnesite and dolomite situated near large blocks of firm power supply. Development has progressed for over 2 years on a process that appears to offer some promise and is based on electrolytic decomposition of magnesium oxide dissolved in a fused magnesium chloride bath. Investigations of this process are continuing.

Investigations on a process for producing magnesium from olivine have proceeded through the pilot-plant stage under the direction of the Tennessee Valley Authority.³ Magnesium chloride suitable for electrolytic reduction to magnesium metal was prepared from olivine by extraction with hydrochloric acid and subsequent purification. The olivine used was from Balsam, N. C., and the deposit had been shown to be typical of the high-grade olivine available at several localities in North Carolina.

Data gathered on retorts used in the ferrosilicon process for production of magnesium from dolomite showed that increased life of retorts with present alloys is possible only by resorting to mechanical means, such as increasing the wall thickness, using reinforcements, and expanding the retort with compressed air each time collapse occurs.⁴

Several interesting papers giving operating data and general descriptions of processes in use during 1944, including the carbothermic process,⁵ the ferrosilicon process,⁶ the Dow sea-water process,⁷ and the Dow process as used by Diamond Magnesium Co.,⁸ are to be found in the technical literature in the past year.

The production of magnesium halides from slaked, calcined dolomite by reaction with a readily hydrolyzable organic halide containing a

² Lloyd, R. R., Stoddard, C. K., Mattingly, K. L., Leidigh, E. T., and Knickerbocker, R. G., Pilot-Plant Production of Electrolytic Magnesium from Magnesite: *Metals Technol.*, April 1945, Tech. Pub. 1848, 25 pp.

³ Houston, E. C., Magnesium from Olivine: *Metals Technol.*, April 1945, Tech. Pub. 1828, 14 pp.

⁴ Foley, F. B., and Sebastian, R. L., Cast Retorts for Magnesium Distillation at 2,160° F., by the Pidgeon Process: *Metals Technol.*, February 1944, Tech. Pub. 1709, 5 pp.

⁵ Dungan, T. A., Production of Magnesium by the Carbothermic Process at Permanente: *Metals Technol.*, February 1944, Tech. Pub. 1671, 7 pp.

⁶ Mayer, Andrew, Plant for Production of Magnesium by the Ferrosilicon Process: *Metals Technol.*, August 1944, Tech. Pub. 1670, 14 pp.

⁷ Shigley, C. M., The Plant of the Dow Magnesium Corporation at Velasco, Tex.: *Metals Technol.*, February 1945, Tech. Pub. 1845, 9 pp.

⁸ Avery, J. M., and Evans, R. F., Production of Magnesium at Painesville, Ohio: *Metals Technol.*, February 1945, Tech. Pub. 1829, 8 pp.

labile halide atom is described in United States Patent 2,338,876. Recovery of the magnesium content of sea water by an improved method to obtain the magnesium in the form of partly hydrated magnesium chloride, substantially free of impurities normally present in the sea water, is the subject of United States Patent 2,342,666. The process involves adding lime or another alkali to the sea water and precipitating the magnesium content as magnesium hydroxide. This product is then treated with calcium chloride and carbon dioxide, resulting in the formation of magnesium chloride solution and precipitated calcium carbonate. After purification the magnesium chloride is evaporated to dryness.

The direct reduction of magnesium and zinc carbonates or oxides to elemental form is described in United States Patent 2,364,742. The compound is mixed with coke and subjected to a blast of highly preheated air which causes combustion of the coke and raises the mixture above the reduction temperature of the metal compound. Then the air blast is replaced by a methane blast, liberating the metal in vapor form. The reaction is endothermic and thus requires alternate blasts of preheated air and methane to maintain output.

A process for pretreating magnesium dust produced by the carbothermal reduction process from magnesite to remove occluded natural gas before tableting or pelleting, was patented by Fritz J. Hansgirk (United States Patent 2,367,020). By this invention the magnesium dust is heated to a temperature at which it becomes plastic (300° to 360° C.), then subjected to a gliding compression, which can be obtained by passing the material between steel rollers having different peripheral speeds, and finally charged to pelleting machines which form the treated flakes into very hard solid pellets. Thus the distillation process can be carried out without causing any flying dust, and the metal collected by condensation is of high purity, according to the patent claims.

Welding in an inert atmosphere, such as helium or argon, prevents ignition of magnesium during welding and is described in United States Patent 2,342,086. Welding fluxes are not used in this method, and the weld is backed by magnesium or other material. In order to maintain the structural strength of the part welded, the weld section has to be increased about 100 percent in area.

POSTWAR OUTLOOK

Capacity to produce primary magnesium in the United States totaled 293,000 short tons annually in 1944, a quantity roughly 90 times that of prewar (1939) output. The tremendous expansion of this industry to meet the demands of war is unequalled by that of any other major metal. At the beginning of the European War in 1939, magnesium production was a comparatively small industry in which there was only one producing company. This company, Dow Chemical Co., produced the metal in connection with its chemical operations at Midland, Mich., and conducted extensive research on fabrication and new uses for magnesium in attempting to obtain its acceptance as a major metal. The potentialities of magnesium as a structural metal had long been recognized because of its extremely light weight and its high strength:weight ratio in alloy form. However, before the war fabrication of magnesium had not advanced enough to cause

its wide acceptance for structural use. Pyrotechnic, alloying, and deoxidizing uses claimed a major share of the output, although structural uses were growing.

During the war two additional privately owned plants were constructed—one by Dow and one by Permanente Metals Corp.—and 12 plants were built for the Defense Plant Corporation by various companies. In addition, many fabrication plants were constructed or converted from other metals to meet needs for magnesium permanent mold, die, and sand castings, as well as for extrusions, forgings, and sheet. During 1943 and the first half of 1944 magnesium assumed critical importance in incendiary bomb casings and in aircraft components. Demands changed constantly owing to shifts in military operations and to improvement of weapons and late in 1944 experienced a large decrease. As a result operations in the industry at the end of 1944 were at only 17 percent of capacity even with a two-front war in progress and with no restrictions on civilian use. Such a drop in demand for the metal is not conducive to optimism as to the immediate postwar outlook for magnesium. A survey of the wartime record leaves no doubt that the industry was greatly overexpanded, even for war, but the great difficulty in predicting war demands made this inevitable. The fact remains, however, that both private industry and Government possess magnesium-producing facilities far in excess of any demand foreseeable for at least a decade after the war.

The price of magnesium has dropped sharply since 1939, falling from 30 cents a pound to 20.5 cents. At present on a volume basis magnesium is cheaper than aluminum, although on a pound basis it is one-third more expensive. With the larger facilities now in use—particularly the efficient sea-water plants—there is no reason for believing that the downward price trend will be arrested at 20.5 cents. The wartime price reduction alone should result in increased demand in the postwar period compared with prewar; further decreases in price undoubtedly will be reflected in greater consumption for existing uses, development of new uses, and an advantageous competitive position in fields now dominated by other metals. An improvement in magnesium's competitive position is not assured, however, as the price of aluminum—a principal competitor—has also been experiencing a downward trend. As with aluminum, the first cost of magnesium in ingot form is not necessarily the decisive cost factor in using the metal in fabricated forms. The costs of casting, rolling, forging, and extruding the metal determine to a considerable extent its price to the consumer. Thus a price reduction of 20 percent in ingot metal may mean only a 5- or 10-percent reduction in the cost of the fabricated article. It seems reasonable to assume, however, that, when techniques of fabrication developed during the war, together with the present modern fabricating facilities, are put to use for civilian output, the cost of fabricating and forming will be reduced.

Magnesium stocks held by the Government and at producing, fabricating, and consuming plants at the end of the war may well represent several years "normal" postwar peacetime consumption. Therefore, the question of how this excess material is to be handled is very important. Stocks of metal in all forms at the end of 1944 are estimated to have been between 75,000 and 100,000 short tons. Even taking the lower estimate, these stocks represent nearly 25 years' supply at the 1939 rate of domestic consumption. Under the

Surplus Property Act of 1944 (Public Law 457—78th Cong.), however, magnesium is considered a "strategic metal," and according to section 22, subsection (a), all Government-owned accumulations shall be transferred to a stock pile under the Procurement Division of the Treasury. This provision will alleviate the stock situation greatly, but industry-owned magnesium surpluses after the war may still be considerable in terms of prewar consumption.

Estimates of postwar consumption of magnesium have varied widely and have ranged from 10,000 to 250,000 tons a year. A glance at the production and consumption record of magnesium from its beginning in the United States in 1915 makes this latter estimate seem almost ridiculously high unless it is intended for some period far in the future. It does not appear reasonable to prognosticate a consumption of more than 75,000 tons a year by the fifth year of peace, and even this figure is regarded as wishful thinking by many experts. Owing to its light weight, magnesium should find new and expanded uses in fields where that property can be used to the fullest advantage, such as in truck bodies, railroad rolling stock, terminal freight facilities, less-than-carlot containers, airplanes, portable tools, industrial machinery, and other items. Consumer goods, such as portable mechanical dishwashers, lawn mowers, and wheelbarrows, offer possibilities for increased use of the metal. In addition, the chemical and alloying uses of magnesium may take a substantial share of the output.

Raw materials for the manufacture of magnesium metal are widespread, and no supply problem exists. Sea water is available as a raw material wherever the ocean shore marks the United States border; dolomite is found in many States in abundant quantities as a common rock; brines high in magnesium chloride are found in Michigan, Kansas, Utah, and other States; and magnesite—the least abundant of magnesium ores—is found in California, Washington, Nevada, and other States. In addition, potential raw materials, such as serpentine and olivine, although not as widespread as some other possible magnesium ores, are found in large deposits in several Eastern and Western States.

The domestic magnesium industry is in an excellent position to compete with producers in other countries for world markets of both ingot metal and fabricated products. Mass production techniques should enable domestic articles made from magnesium to compete to advantage with other nations in foreign markets.

Owing to its abundance and light weight, magnesium should become one of the important nonferrous industrial metals of the future. When that time will arrive it is not possible to say, but it does not seem likely to be within the next decade. Continuously advancing technology, greater stress on weight saving, and probable lower future costs appear to insure magnesium a promising future.

WORLD PRODUCTION

World output in 1944 is estimated at 235,100 metric tons, or 13 percent less than the all-time record production of 269,800 tons estimated for 1943. It is believed that the bulk of the wartime expansion programs in the various foreign countries, with the possible exception of Japan, were completed by 1944, and in fact production was con-

siderably reduced by curtailments of excess output by the two largest magnesium producers among the United Nations—the United States and the United Kingdom. The statistical data upon which the estimates of production by the Axis countries are based are very meager, but it is believed that about 29 percent of the world output was under Axis control and about 71 percent under United Nations control. World production in 1945 is expected to be considerably reduced owing to the surrender of the Axis Nations in Europe.

Estimated world production of magnesium, 1940–44, by countries, in metric tons

Country	1940	1941	1942	1943	1944
Australia.....		200	430	800	900
Canada ¹		6	367	3,245	4,835
France ¹	2,562	1,908	1,332	1,741	842
Germany.....	25,000	35,000	40,000	50,000	45,000
Italy.....	500	2,500	5,000	5,000	3,000
Japan.....	3,000	5,000	12,000	15,000	17,000
Norway.....		100	2,000	2,000	2,000
Switzerland.....	750	1,000	1,500	1,500	1,000
U. S. S. R.....	1,500	4,000	5,000	5,000	5,000
United Kingdom.....	6,500	12,000	16,500	19,000	13,000
United States ¹	5,680	14,782	44,418	166,544	142,518
Total.....	45,500	76,500	128,500	269,800	235,100

¹ Actual production.

Canada.—Canadian production of magnesium, which increased 49 percent in 1944, was not affected by the large cut-backs in United States output, since orders from Great Britain continued to demand all that could be produced. The only plant producing magnesium was at Haley's Station near Renfrew, Ontario, operated by Dominion Magnesium, Ltd., and using the Pidgeon ferrosilicon process. The company owns the world patents on the process and has first option to buy the plant from the Dominion Government at the end of the war. Production costs, high at first, were reportedly down to 21 cents a pound in the spring of 1944, and it was believed that this figure could be substantially reduced with further operating experience to a point competitive with magnesium made by electrolytic methods.

The raw material, dolomite, used in the plant, is obtained from a deposit at the plant site. It is a high-purity crystalline dolomite of the Grenville series, and analyses of the material show a magnesium oxide content ranging from 20.48 to 21.55 percent, with only 0.25 to 0.65 percent insolubles.

Mid-Canada Magnesium Mines, Ltd., plans to begin construction at an early date of the first unit of a magnesium plant near Renfrew, Ontario.⁹ This unit will cost \$100,000 and will have a capacity of 1,500 pounds of refined metal per day. It is claimed that magnesium can be produced from dolomite for 10 cents a pound by the process to be used in the plant—the Keemle electrothermic process.

France.—No serious damage was done to any of the four French magnesium plants as a result of the war or German occupation. The plant of Compagnie Alais, Froges et Camargue at St. Auban, Basses Alpes, uses the I. G. Farbenindustrie process to produce magnesium

⁹ Iron Age, Canadian Firm Plans Magnesium Refining: Vol. 154, No. 14, October 5, 1944, p. 110.

from magnesite and has an annual capacity of 1,560 metric tons. The same process is used by the Société d'Électro-chimie, d'Électro-metallurgie et des Aciéries Électriques d'Ugine at Jarrie, Isere, in a plant which has an annual capacity of 1,800 metric tons. The Société des Produits Azotes at Lannemezan, Étes-Pyrenees uses the Murex, Ltd., carbide-reduction process in its 1,200-ton a year plant. Small quantities of magnesium are also produced by the Société Bozel-Maletra et Villard, Savoie. Grecian magnesite is the raw material used at the first three plants mentioned, but no data are available on operations of the fourth company. According to statistics issued by the Société Général du Magnesium for 1941 to 1944 only the Isere plant operated during that period. All production apparently ceased late in 1944, and the prospects for the industry in 1945 depend on the availability of magnesite.

United Kingdom.—The British price for magnesium was stabilized at £168 a long ton throughout 1944, or almost double the recently reduced price of aluminum in the United Kingdom. Converted to United States currency, this price is the equivalent of 30.225 cents a pound compared with the United States price of 20.5 cents. A report of the Select Committee on National Expenditure stated that much of the expanded wartime output cost even more to produce than the present market price. Production during 1944 is believed to have been considerably reduced, owing to cessation of operations at one of the four producing plants and curtailment of output at two others. Probably more than half of the magnesium requirements of British industry were met through imports from the United States and Canada.

ANTIMONY

By THOMAS P. WOOTTON

SUMMARY OUTLINE

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SUMMARY

Government control of antimony was considerably less severe in 1944 than during the previous year. However, toward the end of the year increasing military demand for the relatively new antimony-consuming fire-retardant paints and flameproofed textiles, coupled with a diminishing supply of antimony available for consumption, necessitated a return to strict control under War Production Board General Preference Order M-112, as amended, effective February 10, 1945. The order limited inventories of ore to 45 days' supply and of all other forms of antimony to 30 days' supply.

Domestic production of antimony ore in 1944 decreased 20 percent below the 1943 output, the total metal content of the ore declining 15 percent. Antimony contained in material imported for consumption decreased 42 percent. The decline in the amount of available domestic antimony was due largely to curtailment of output of tetrahydrite ores in Idaho and reduced activity at Alaskan mines. Lack of ships, decrease in price, and tightening of grade specifications for Bolivian ores combined to reduce imports of South American ores by more than 10,000 tons of contained antimony. The antimony content of antimonial lead produced from all classes of foreign and domestic ore increased 37 percent, and recovery from scrap increased 40 percent. Industry-owned stocks increased slightly, but total inventories, including those of Metals Reserve Company in the United States, decreased 25 percent.

The price of American antimony metal in less than carlots remained 15.84 cents a pound throughout the year. This compares with an average price of 15.92 cents a pound in 1943, 15.55 cents in 1942, and 14.00 cents in 1941 and 1940. The prices for antimony ores and concentrates remained unchanged throughout the year. The 50- to 55-percent ores were quoted at \$2.10 to \$2.20 per short-ton unit of contained antimony at New York.

Figure 1 shows trends in world production from 1910 to 1938 and United States imports and prices from 1910 to 1944.

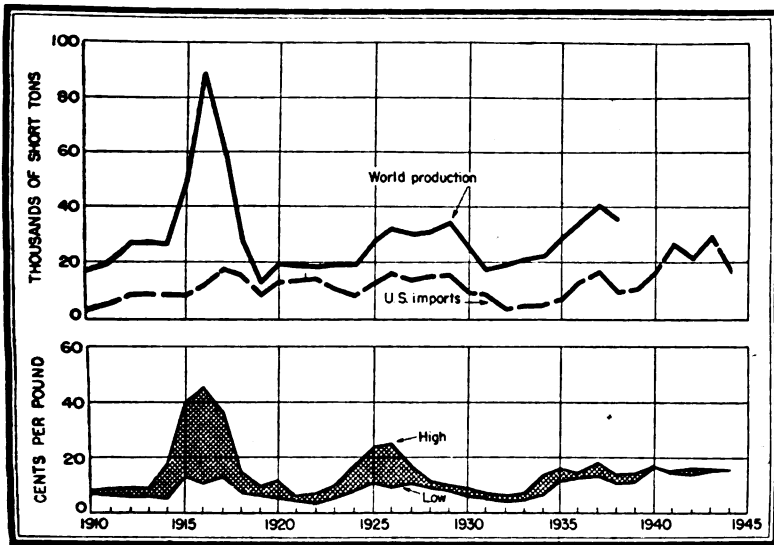


FIGURE 1.—Trends in world production, 1910-38, and United States imports and New York price of antimony, 1910-44

Salient statistics for antimony in the United States, 1940-44

	1940	1941	1942	1943	1944
Production of antimony ore and concentrates short tons..	1,124	3,460	6,980	16,785	13,501
Antimony contained.....do.	494	1,214	2,944	¹ 5,568	4,735
Antimony content of antimonial lead produced from domestic and foreign ores.....short tons..	2,077	2,958	3,267	¹ 2,085	2,857
Secondary antimony produced.....do.	11,421	21,629	18,200	15,483	15,886
Imports for consumption:					
Antimony in ore.....do.	15,733	19,386	20,946	28,755	16,824
Needle or liquated antimony.....do.	113	638	522	1	-----
Metal.....do.	209	7,469	127	932	293
Oxide and other compounds.....do.	5	2	(²)	(²)	-----
Exports of antimony ore, metal, and compounds short tons..	³ 276	³ 70	230	494	1,319
Consumption of primary antimony.....do.	⁴ 17,955	⁴ 20,994	⁴ 23,852	19,508	23,756
Stocks of antimony in bonded warehouse at end of year.....short tons..	3,417	416	(⁵)	(⁵)	(⁵)
Average price of antimony at New York: ⁶					
Chinese.....cents per pound..	⁷ 16.50	⁷ 16.50	⁷ 16.50	⁷ 16.50	⁷ 16.50
American.....do.	14.00	14.00	15.55	15.92	15.84
World production.....short tons..	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)

¹ Revised figure.

² Less than 1 ton.

³ Includes only foreign metal.

⁴ Primary antimony available for consumption; data not strictly comparable with figures for 1943 and 1944.

⁵ Figures not available.

⁶ According to American Metal Market.

⁷ Nominal.

POSTWAR OUTLOOK

Consumption.—The expectation is that consumption of metallic antimony and antimony oxide for some time after the war will be higher than the prewar rate.

Demand for passenger automobiles and for industrial and farm vehicles and power units, with their accompanying requirements for

battery and bearing metals, will be tremendous. The use of antimony in alloys for manufacturing ornamental castings, collapsible tubes, and foil at least will return to normal after restrictions are no longer necessary.

Consumption of antimony oxide in the production of flameproofed textiles and fire-retardant paints will diminish with the inevitable decrease in military demand. However, these uses for the civilian market, now that war-born necessity has proved their efficacy, are expected to be high, with a consequent over-all increase in consumption of oxide above the prewar level. The successful application of flameproofing compounds to military textiles may well point the way to their use on such commonplace things as household draperies and awnings, theater curtains, and commercial tentage and tarpaulins.

Production.—The outlook for domestic mine production of antimony ores and concentrates is not good. That for smelter production of antimony metal and oxide is contingent upon the success of Chinese metal in recapturing its former large share of the United States market.

As 95 percent of the antimony contained in domestic ores produced during 1944 came from four Idaho mines operated primarily for lead, silver, tungsten, or copper and only 3 percent came from mines operated solely for antimony, future production obviously will continue to be largely as a byproduct and to depend on the output of other metals. Production of antimony metal from antimony ores can be expected if a high price, caused either by sustained demand or Government subsidy, is maintained, but such production—if past records are any criterion—will be relatively negligible. Only high prices for the metals with which antimony is associated in other deposits will keep operators such as Bradley Mining Co., Sunshine Mining Co., and Coeur d'Alene Mines Corp. in antimony production.

Imports.—Imports will continue to supply most of the domestic requirements of antimony, but the origin of these imports is conjectural.

Bolivian operators will continue to mine and export ore as long as the price is high enough for the controlling dealers to make a profit, and some of this ore will find its way to the United States. Similarly, Mexican output will continue, and most of it undoubtedly will be shipped to the United States as refined metal and contained in ore and antimonial lead. Receipts of antimony from both countries will depend to some extent on competition from European buyers.

Reestablishment of peace in China certainly would have a profound effect on world trade in antimony. Production in that country has been disrupted for more than a decade due to war. During the 5-year period 1930–34 United States imports of antimony metal and antimony contained in ore averaged 6,400 tons a year, 3,500 tons or 55 percent of which was Chinese metal. Chinese antimony resources are adequate to support a production much greater than has been made at any time in the past. Moreover, the certain need for United States credits points to the offering of Chinese antimony at competitive prices below those domestic producers are likely to be able to meet.

DOMESTIC MINE PRODUCTION

Only 11 antimony-producing mines reported any output in 1944 compared with 17 in 1943 and 31 in 1942. Production of ore and concentrates dropped 20 percent to 13,501 tons, the 4,735 tons of contained

metal being 15 percent lower than the comparable total for 1943. The Yellow Pine mine of the Bradley Mining Co., Valley County, Idaho, produced 91 percent of the antimony contained in domestic ores and concentrates. Only 140 tons or 3 percent of the antimony content of all ores and concentrates produced was from straight antimony ores, the remainder being contained in ores valued chiefly for their content of other metals.

Alaska.—Only one mine in Alaska is known to have produced antimony ore during 1944. Ernest Maurer shipped 73 tons of 48-percent ore from his Slate Creek mine in the Kantishna district to the Metals Reserve Company stock pile at Fairbanks. No report was received from Earl Pilgrim regarding operations at the Stampede mine, also in the Kantishna district. According to the Geological Survey, operations at this mine ceased early in 1944.

California.—On the basis of reports to the Bureau of Mines and Metals Reserve Company purchase records, it is estimated that approximately 15 tons of ore containing 5 tons of antimony were produced from three mines in Inyo, Kern, and Riverside Counties.

Idaho.—The mines of Shoshone and Valley Counties continued to yield most of the antimony obtained from domestic sources. The Yellow Pine mine of the Bradley Mining Co. and the Mineral Point mine of the Coeur d'Alene Mines Corp. were by far the most important. The Sunshine Mining Co. closed its electrolytic antimony plant in March 1944. Production from the Sunshine mine dropped nearly 95 percent for the year as the company directed its entire attention from the "dry-belt" silver ores to the newly developed silver-lead ores of the Chester vein.

Nevada.—Antimony mining in Nevada decreased slightly during 1944; three operators produced 74 tons of ore containing 30 tons of metal.

In November 1944 the Metals Reserve Company announced that purchase depots at Battle Mountain and Winnemucca would cease to receive antimony ores after December 31, 1944.

Oregon.—According to a recent report¹ there are five mines in Oregon of which there is a record of production. These are the Gray Eagle (formerly the Koehler), the Coyote, the Stibnite (also known as the Parker), the Jay Bird, and the Lowry. There are also at least seven prospects from which no production has been recorded. The Gray Eagle and the Jay Bird mines were the only known producers of antimony ore during 1944.

The Gray Eagle mine in Baker County, owned and operated by Anthony Brandenthaler, yielded 1,170 tons of low-grade antimony-gold ore, which was shipped to the U. S. Smelting, Refining & Mining Co. plant at Midvale, Utah, and 78 tons of high-grade antimony ore, which was shipped to the Metals Reserve Company depot, Seneca, Oreg. This mine was first worked in 1907, and small shipments have been made at infrequent intervals since that time. The preparation of the ore for shipment consists of dumping the mine-run ore on a grizzly with half-inch openings. The oversize is hand-sorted to obtain antimony ore, and the undersize is shipped as antimony-gold ore. Most of the antimony is present in the oxide minerals stibiconite and cervantite.

¹Wagner, Norman S., Antimony in Oregon: Oregon Dept. Geol. and Mineral Industries, G. M. I. Short Paper 12, 1944, 20 pp.

The Jay Bird mine in Jackson County was discovered in 1939 and was acquired by its present owners, S. J. and E. P. Merrick, in 1941. Under the Merrick brothers the mine has yielded approximately 125 tons of ore containing about 47 percent antimony. The dominant mineral is the sulfide stibnite, but some kermesite—the oxysulfide—is mined. During 1944 the ore was hand sorted and shipped to the Metals Reserve Company stock pile at Grant's Pass, Oreg.

Utah.—The Dry Lake Mining Co., with property in Hunsaker Canyon, Box Elder County, was again the only producer of antimony ore in Utah.

CONSUMPTION AND PRODUCTION BY SMELTERS AND MANUFACTURERS

Primary antimony raw materials (including various types of ores and concentrates) were consumed by producers of the intermediate products antimony metal, oxide, and sulfide and by manufacturers of finished metallic and nonmetallic products. Together these two groups used 22,675 tons of antimony contained in ores and concentrates during the year—a 4-percent decrease from the 1943 figure. Only 45 percent of the total consumed was from mixed or oxide ore—mostly from Mexico—as compared with 56 percent in 1943. A sharp decrease in consumption of tetraedrite concentrates came as a result of the Sunshine Mining Co. shift from mining “dry-belt” ores to the silver-lead ores of the Chester vein.

Antimony ores and concentrates at smelters and manufacturers in 1944, in short tons of contained antimony

Raw materials	Stocks on Dec. 31, 1943 ¹	Net receipts	Consump- tion	Stocks on Dec. 31, 1944
Chemical-grade sulfide ore.....	338	7,216	6,711	843
Metallurgical-grade sulfide ore.....	415	2,025	2,065	355
Mixed or oxide ore.....	920	10,233	10,163	990
Sulfide concentrates.....	1,484	3,012	3,642	854
Tetraedrite concentrates.....	.....	74	74	.....
Total ore.....	3,157	22,560	22,675	3,042

¹ Revised figures.

Smelter production.—Nine plants consumed 22,000 tons of antimony in raw materials, including 19,000 tons in ores and concentrates, and produced antimony metal, oxide, and sulfide containing 20,000 tons of antimony, slightly less than the 1943 output. The Bureau of Mines is not at liberty to publish separate figures on the output of these three intermediate primary products. Antimony metal was produced at five plants in the United States during the year, oxide was manufactured at seven plants, and sulfide at three plants.

The Texas Mining & Smelting Co., Laredo, Tex., continued to depend mainly on mixed and oxide ores from Mexico but also used some domestic sulfide ores and Bradley Mining Co. (Yellow Pine mine) concentrates to make antimony metal and oxide. The Sunshine Mining Co. closed its electrolytic plant in March 1944. The electrolytic plant of Bunker Hill & Sullivan Mining & Concentrating Co. was operated throughout the year on stibnite concentrates from the Yellow Pine area. The Harshaw Chemical Co. produced metal and

oxide at its El Segundo (Calif.) plant, oxide at Elyria, Ohio, and sulfide at Philadelphia. The American Smelting & Refining Co. produced metal and oxide at Omaha and oxide at Perth Amboy. The McGean Chemical Co. made oxide and sulfide at Cleveland, Metal & Thermit Corp. made oxide at Carteret, and Rare Metal Products Co. made sulfide at Belleville, N. J.

Production by manufacturers.—In 1944, antimony ores and concentrates and antimony metal, oxide, and sulfides containing 23,756 tons of antimony were consumed at 400 plants in the production of the metal and nonmetal products listed in the following table.

Industrial consumption of primary antimony, 1943-44, in short tons

[Antimony content of raw materials, including ores and concentrates, metal, oxide, and sulfides, put in process]

Product	Antimony consumed in the manufacture of products listed	
	1943	1944
Metal products:		
Antimonial lead.....	2,889	5,287
Bearing metal and bearings.....	1,563	2,637
Battery metal and battery parts.....	2,400	2,341
Type metal and type.....	856	841
Cable covering.....	447	422
Sheet and pipe.....	176	326
Castings.....	198	115
Collapsible tubes and foil.....	132	114
Ammunition.....	359	63
Solder.....	129	71
Total metal products.....	9,179	12,247
Nonmetal products:		
Flameproofed textiles.....	6,952	7,063
Paints and lacquers.....	1,859	2,490
Frits and ceramic enamels.....	281	501
Glass and pottery.....	537	411
Sodium antimonate.....	47	369
Antimony trichloride.....	153	289
Ammunition primers.....	97	43
Matches.....	18	10
Other.....	385	333
Total nonmetal products.....	10,329	11,509
Grand total.....	19,508	23,756

Use of antimony in the production of all the major metal and non-metal products listed except battery metal and battery parts and flameproofed textiles increased sharply. The use of antimony oxide in flameproofing compounds for application to cotton duck, web belting, camouflage nets, and similar products and in fire-retardant and other paints accounted for 61 percent of the antimony used in the manufacture of nonmetal products and 30 percent of the total consumed for making all commodities.

Primary lead smelters produced 57,902 tons of antimonial lead containing 4,670 tons (8.1 percent) of antimony. The probable reason for the gain in antimony content from 5.3 percent in 1943 is the cut-back in small arms ammunition production in 1944 and consequent less demand for the lower-percentage antimonial lead used for bullet core rod. Of the total 1944 tonnage produced, 43

percent of the contained antimony was derived from domestic ores, 18 percent from foreign ores, and 39 percent from scrap. Details are presented in the accompanying table.

Antimonial lead produced at primary lead refineries, 1940-44, in short tons

Year	Production	Antimony content				
		From domestic ores ¹	From foreign ores ²	From scrap	Total	
					Quantity	Percent
1940.....	29,762	1,915	162	867	2,944	9.9
1941.....	40,237	2,586	372	552	3,510	8.7
1942.....	51,762	2,396	871	257	3,524	6.8
1943.....	63,515	³ 1,591	³ 494	³ 1,286	3,371	5.3
1944.....	57,902	2,015	842	1,813	4,670	8.1

¹ Includes primary residues and small quantity of antimony ore.

² Includes foreign base bullion and small quantity of foreign antimony ore.

³ Revised figure.

STOCKS

Combined producer and consumer inventories of antimony metal and of antimony in ores and concentrates, oxide, and sulfide increased slightly from 8,089 tons on December 31, 1943, to 8,165 tons on December 31, 1944. In addition to the above, there were mine stocks of 5,114 tons in domestic ores and concentrates. The supply of raw materials available from these two sources for the manufacture of finished products was therefore 13,279 tons (antimony content), or 11 percent more than the 11,915 tons available at the end of 1943, excluding Metals Reserve Company stocks.

SECONDARY PRODUCTION

The Minerals Yearbook chapter on Secondary Metals—Nonferrous presents a detailed review of the secondary antimony industry. The combined recovery of secondary and primary antimony during 1944 amounted to 39,642 tons, of which 15,886 tons or 40 percent was from secondary sources. Old battery lead plates continued to supply the bulk of the secondary antimony.

PRICES

The price of domestic brands of antimony metal, 99.5 percent minimum, in less than carlots remained at 15.84 cents a pound and of Chinese brands (duty paid) at 16.50 cents a pound (nominal), throughout the year. The price of domestic metal in bulk, f. o. b. Laredo, Tex., remained 14.50 cents. The London price for metal, 99 percent minimum, remained £120 a ton until January 1, 1945, when the official price was lowered to £105.

Quotations for antimony ores and concentrates, according to E&MJ Metal and Mineral Markets, remained throughout the year \$2.10 @ \$2.20 a short-ton unit for the 50- to 55-percent grade; \$2.15 @ \$2.20 for 58 to 60 percent; and \$2.20 @ \$2.30 for 60 to 65 percent. The London price at the beginning of the year was 12s. 6d. a long-ton unit. About the middle of the year this dropped to 12s. then to 11s. 6d., and closed at 11s.

Average monthly quoted prices of antimony, prompt delivery at New York, 1940-44, in cents per pound, for less than carlots

Month	Chinese brands (duty paid) ¹					American brands ²				
	1940 ³	1941 ³	1942 ³	1943 ³	1944 ³	1940	1941	1942	1943	1944
January.....	16.50	16.50	16.50	16.50	16.50	14.00	14.00	14.00	16.05	15.84
February.....	16.50	16.50	16.50	16.50	16.50	14.00	14.00	14.00	16.05	15.84
March.....	16.50	16.50	16.50	16.50	16.50	14.00	14.00	14.62	16.05	15.84
April.....	16.50	16.50	16.50	16.50	16.50	14.00	14.00	15.90	16.05	15.84
May.....	16.50	16.50	16.50	16.50	16.50	14.00	14.00	16.01	15.94	15.84
June.....	16.50	16.50	16.50	16.50	16.50	14.00	14.00	16.01	15.84	15.84
July.....	16.50	16.50	16.50	16.50	16.50	14.00	14.00	16.01	15.84	15.84
August.....	16.50	16.50	16.50	16.50	16.50	14.00	14.00	16.01	15.84	15.84
September.....	16.50	16.50	16.50	16.50	16.50	14.00	14.00	16.01	15.84	15.84
October.....	16.50	16.50	16.50	16.50	16.50	14.00	14.00	16.01	15.84	15.84
November.....	16.50	16.50	16.50	15.60	16.50	14.00	14.00	16.01	15.84	15.84
December.....	16.50	16.50	16.50	16.50	16.50	14.00	14.00	16.02	15.84	15.84
Average.....	16.50	16.50	16.50	16.50	16.50	14.00	14.00	15.55	15.92	15.84

¹ From daily issues of American Metal Market.

² Metal Statistics, 1945, p. 579.

³ Nominal.

WAR AGENCY REGULATIONS

Antimony was removed from allocation control by an amendment to War Production Board General Preference Order M-112 dated December 4, 1943, effective January 1, 1944, and remained on the "free" list throughout the year. Consumers were still required to report to the Board, but the reports were to be filed quarterly instead of monthly. Toward the end of the year demand increased to the extent that the necessity for resumption of control became apparent. Accordingly, on February 3, 1945, the order was amended, effective February 10, requiring monthly reports and applications for allocation of antimony in its various forms. This amendment required any firm that had in its possession on the first of any calendar month, or that had used during the previous month, 2,240 pounds or more of antimony contained in ore or in any alloy or compound, to submit the required monthly report of activities.

Demand, particularly for antimony oxide, continued to exceed supply and producing capacity, and on March 14, 1945, General Preference Order M-112 was amended further to include possessors or consumers of 224 pounds of contained antimony.

FOREIGN TRADE ²

Detailed information on the imports and exports of antimony materials are presented in the following tables.

Antimony imported for consumption in the United States, 1940-44

Year	Antimony ore			Needle or liquated antimony		Antimony metal		Antimony oxides and other compounds	
	Short tons	Antimony content		Short tons	Value	Short tons	Value	Short tons	Value
		Short tons	Value						
1940.....	37,966	15,733	\$2,027,612	113	\$19,464	209	\$50,048	5	\$1,851
1941.....	41,662	19,346	2,717,472	638	126,018	7,469	2,056,678	2	537
1942.....	50,033	20,946	3,943,402	522	101,164	127	28,904	(1)	5
1943.....	63,187	28,755	5,351,852	1	172	932	267,916	(1)	3
1944.....	41,812	16,824	2,700,747			293	105,667		

¹ Less than 1 ton.

² Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Antimony imported into the United States, 1943-44, by countries, in short tons ¹

Country	Antimony ore			Antimony metal	
	Gross weight (short tons)	Antimony content		Short tons	Value
		Short tons	Value		
1943					
Bolivia.....	22,304	13,833	\$2,917,927		
Canada.....	(²)	(²)	55	(²)	\$13
Chile ³	12	6	1,100		
Cuba.....	22	6	1,456		
Honduras ⁴	236	144	37,408		
Mexico.....	37,621	12,673	1,083,943	643	203,301
Peru.....	3,119	2,131	404,323	289	64,596
Turkey.....	121	61	13,840		
United Kingdom ⁵				(²)	6
	63,435	28,954	5,360,057	932	267,916
1944					
Bolivia.....	7,168	4,194	844,465		
Chile ³	774	485	91,816		
China.....				(²)	7
Honduras ⁴	166	106	15,421		
Mexico.....	31,851	11,087	1,564,455	220	87,803
Peru.....	1,446	752	130,791	74	17,857
	41,405	16,624	2,646,948	294	105,667

¹ Data include antimony imported for immediate consumption plus material entering the country under bond.

² Less than 1 ton.

³ Probably mined in Bolivia or Peru and shipped from a port in Chile.

⁴ Includes 205 tons of ore containing 124 tons of antimony in 1943 and 77 tons of ore containing 48 tons of antimony in 1944 mined in Honduras but credited by the U. S. Department of Commerce to Guatemala.

⁵ United Kingdom of Great Britain and Northern Ireland.

Estimated antimony content in type metal, antimonial lead, and other alloys imported for consumption in the United States, 1940-44, in short tons ¹

Year	Type metal and antimonial lead	Other alloys ²	Total	Year	Type metal and antimonial lead	Other alloys ²	Total
1940.....	191		191	1943.....	281		281
1941.....	202		202	1944.....	388		388
1942.....	35		35				

¹ For details of gross weight and values, see imports shown in Lead chapter of this volume.

² Chiefly in special antimony-lead alloys containing high percentage of antimony.

Foreign antimony (regulus or metal) exported from the United States, 1940-44

Year	Short tons	Value	Year	Short tons	Value
1940.....	276	\$75,440	1943.....	(¹)	\$200
1941.....	70	19,690	1944.....	18	5,445
1942.....	(¹)	181			

¹ Less than 1 ton.

Although domestic production of antimony ores has been increasing during recent years, the United States still depends on imports of foreign ores for its supply.

Most of the ores—which come from Mexico—are of the mixed or oxide type containing 30 to 35 percent antimony. During 1944 Mexico furnished 11,087 tons of antimony contained in ores and 220 tons of metal.

Bolivia has been our second most important source of antimony contained in ores and our most important source of high-grade ores. The types imported are chemical grade, for oxide production, and metallurgical grade, suitable for the production of metal or alloys.

Imports of 752 tons of metal contained in ore and 74 tons of metal were credited from Peru in 1944. The records show small quantities of ore imported from Chile, but probably this was mined in Bolivia or Peru and shipped from a Chilean port. Imports from China have been cut off since 1941, during which year 7,115 tons of metal were received from that country.

Exports of domestic antimony materials in 1944 amounted to 1,319 short tons (gross weight), including 574 tons of antimony compounds, 696 tons of metal and alloys, and 49 tons of ores and concentrates.

Reexports of foreign materials included 604 tons of ores and concentrates (gross weight) and 18 tons of metal and alloys.

WORLD PRODUCTION

Many war-period data on the antimony industry of the world, previously concealed, became available during 1944. Reports were received for the first time in recent years from Portugal, Spain, Morocco, and China, as well as official production figures for several other countries. It is still impossible, however, to arrive at a reasonably accurate figure on total world production for any year later than 1938.

World production of antimony, 1938-44, by countries, in metric tons¹

[Compiled by B. B. Waldbauer]

Country ¹	1938	1939	1940	1941	1942	1943	1944
North America:							
Canada.....	34	550	1,083	1,329	1,269	465	817
Honduras.....			(²)	23	103	110	65
Mexico.....	7,391	7,243	11,286	10,241	10,759	12,585	10,056
United States.....	542	328	412	1,013	2,457	4,638	3,952
South America:							
Argentina.....	174	97	91	123	41	43	(³)
Bolivia (exports).....	8,682	9,255	10,813	13,680	16,231	16,536	6,852
Peru.....	753	775	809	1,440	1,457	2,472	914
Europe:							
Czechoslovakia.....	800	1,012	1,104	1,645	3,130	(⁴)	(⁵)
France.....					128	153	107
Germany (Austria).....	145	(⁶)	(⁷)	(⁸)	(⁹)	(¹⁰)	(¹¹)
Greece.....		1	(¹²)	(¹³)	(¹⁴)	(¹⁵)	(¹⁶)
Italy.....	851	674	(¹⁷)	(¹⁸)	(¹⁹)	(²⁰)	(²¹)
Portugal.....	131	174	247	46	(²²)	115	139
Spain.....		22	3	101	210	176	122
Yugoslavia.....	2,739	3,337	4,860	(²³)	(²⁴)	(²⁵)	(²⁶)
Asia:							
Borneo, British.....		14	41	(²⁷)	(²⁸)	(²⁹)	(³⁰)
Burma.....	84	(³¹)	(³²)	(³³)	(³⁴)	(³⁵)	(³⁶)
China.....	7,797	6,497	5,493	(³⁷)	3,510	428	203
India, British.....	11	(³⁸)	(³⁹)	(⁴⁰)	(⁴¹)	(⁴²)	(⁴³)
Indochina.....	83	19	9	(⁴⁴)	(⁴⁵)	(⁴⁶)	(⁴⁷)
Turkey (Asia Minor).....	398	460	128	5	600	8	(⁴⁸)
Africa:							
Algeria.....	744	(⁴⁹)	(⁵⁰)	478	328	184	(⁵¹)
Morocco:							
French.....	125	420	427	177	235	396	180
Spanish.....	107	54	67	85	144	153	18
South Rhodesia.....	63	50	116	93	155	167	(⁵²)
Union of South Africa.....	10	6	126	445	990	1,560	1,150
Oceania:							
Australia:							
New South Wales.....	67	37	44	147	207	196	(⁵³)
Queensland.....	8		8	25	11	(⁵⁴)	(⁵⁵)
Victoria.....	195	100	14	15	6	(⁵⁶)	(⁵⁷)
Western Australia.....	316	340	247	289	826	(⁵⁸)	(⁵⁹)
New Zealand.....	1		1	8	(⁶⁰)		(⁶¹)
	32,251	(⁶²)	(⁶³)	(⁶⁴)	(⁶⁵)	(⁶⁶)	(⁶⁷)

¹ Approximate recoverable metal content of ore produced exclusive of antimonial lead ores. 92 percent of reported gross content is used as basis for calculations in nearly every instance. Chosen and Japan produce antimony, but data on production are not available.

² Estimate.

³ Data not available.

⁴ Includes antimony content of antimonial lead.

⁵ Figures represent antimony content of regulus, crude antimony, and oxide exported.

⁶ Production of Free China.

⁷ Exports.

⁸ January to June, inclusive.

REVIEW BY COUNTRIES

Algeria.—Ores from the Ain Kerma and Kheneg mines in Algeria have been the French smelting industry's principal source of supply in recent years, but these deposits are said to be rapidly nearing exhaustion. Recorded production dropped from 478 metric tons of estimated recoverable metal in 1941 to 184 tons in 1943, the latest year for which figures are available.

Argentina.—The relatively small requirements for antimony in Argentina are usually met by production from mines in the Department of Rinconada, Province of Jujuy, supplemented by imports from Bolivia. To encourage the domestic metallurgic industry, antimony ore imported for the production of metallic antimony was declared free of import duties by Executive Decree 22,813, dated August 25, 1944.

Belgium.—Mr. Charles Gitlan, New York, informed the author in May 1945 that the plant of the Campine of Belgium, Antwerp, was not damaged during the German occupation and was but slightly damaged during the liberation. The works have been repaired, and the company is now seeking antimony ores for the production of antimony metal, oxide, and alloys.

Bolivia.—A recent press dispatch ^a from La Paz states that Banco Minero has announced an increase in prices for antimony ores and will accept ores of lower grade and increased allowable impurities. For more than a year Banco Minero would not buy ore containing less than 60 percent antimony or more than 0.5 percent of lead and arsenic combined. This restriction on grade imposed by one of the country's largest dealers in antimony, plus a shortage of ships, caused production and exports to decrease 58 percent to 6,852 metric tons of recoverable metal, the lowest since 1937.

Canada.—The Consolidated Mining & Smelting Co., Trail, British Columbia, was the principal producer of metallic antimony in 1944. The metal is recovered electrolytically as a byproduct from smelting operations on complex ores. Production for the year increased 75 percent to 817 metric tons of recoverable metal. Canadian consumption apparently is much greater than this production, for in mid-1944 the Canadian Metals Controller, Department of Munitions and Supply, granted some consumers permission to import American antimony at a considerable increase over the official Canadian ceiling price. In April 1945 the Metals Controller reinstated restrictions on the sale of antimony, including antimonial lead containing 25 percent or more of antimony, and required that all persons possessing the metal or its alloys report each month on inventory, consumption, receipts, and shipments.

China.—Chinese reserves of antimony ores probably are larger than those of any other country. The following table, compiled in 1941 by the Chinese Government Ministry of Economic Affairs, gives estimates of these reserves by Provinces. Only ores that can be recovered by current primitive mining methods are included. No data as to the grade of the ores were given.

^a American Metal Market, May 18, 1945.

Antimony ore reserves of China

Province	Locality	Mineral	Ore reserves (metric tons)
Hunan.....	Sikuangshan, Sinhua.....	Stibnite.....	970, 000
	Wuchi, Yuanling.....	do.....	107, 000
	Shaoyang, Iyang, etc.....	do.....	338, 500
			1, 415, 500
Kweichow.....	Fantsingshan, Kiangkou.....	do.....	400, 000
	Miaolin, Tushan.....	do.....	3, 000
	Pamong, Jungkiang.....	do.....	15, 000
	Huoshao-shai, and Wufengshau, Sanho, Tukiang.....	do.....	41, 040
	Miaolungshan, Sanho.....	do.....	17, 160
	Kaotung, Sanho.....	do.....	2, 880
	Hs'ipai, Sanho.....	do.....	272
	Tsasha, Pachai.....	do.....	288
			479, 640
Kwangsi.....	Hochi, Nantan.....	do.....	51, 257
	Yiukiang region.....	Kermesite.....	100, 000
Yunnan and others.....			151, 257
			400, 000
Total.....			2, 446, 397

During the 10-year period from 1931 to 1940, China produced 116,674 metric tons of antimony metal, 14,914 tons of liquated sulfide, and 7,177 tons of oxide. Of these totals the mines of Hunan Province yielded 95.6 percent of the metal, 98.8 percent of the sulfide, and all of the oxide. Changsha, capital of Hunan and center of the Chinese antimony industry, was captured by the Japanese in June 1944. A year later Chinese troops with American support were driving the Japanese out of the Province. Owing to the war antimony production in Free China dropped from 3,510 metric tons in 1942 to 428 tons in 1943 and 203 in 1944. In 1942, 17 tons of antimony metal were exported to the United States and 71 tons to Russia. There were no exports in 1943 or 1944.

China has never consumed more than an insignificant quantity of antimony—100 to 200 tons a year being used to manufacture matches, firecrackers, and enamel. Recently, however, the Chinese Government has established a factory for the manufacture of pigments in an effort to increase domestic consumption and a refinery for making higher-grade metal in a bid for foreign trade.

At the Chinese Government Industrial and Mining Exhibition in 1944, antimony white, antimony red, antimony yellow, antimony blue, and enamels were exhibited. The old classification for No. 1 Chinese antimony was a minimum of 99 percent antimony and a maximum of 0.3 percent arsenic. The newly established grades of refined metal are: (1) 99.8 percent antimony, minimum, and 0.1 percent arsenic, maximum; (2) 99.6 percent antimony, minimum, and 0.2 percent arsenic, maximum; (3) 99.0 percent antimony, minimum, and 0.25 percent arsenic, maximum. These higher grades are produced by oxidation with compressed air, using soda ash as a dearsenizer.

According to the Central Planning Board of the Supreme National Defense Council of China, as reported by the Foreign Commerce Weekly (United States), production of metallic antimony in the first

postwar year is expected to be 3,000 metric tons, increasing to 15,000 tons by the fifth year. Domestic consumption is expected to increase from an estimated 500 tons in the first postwar year to as high as 1,000 tons annually, leaving 2,500 to 14,000 tons available for export.

France.—Past French production has come from stibnite deposits near Lucette, in the Department of Nayenne, where a small smelter was operated before the war, and from Cuche, in the border region of Cantal and Haute-Loire, where the reopened Doze mine is producing 15 to 20 tons of concentrates a month.

This year, for the first time since 1934, France appears in the table of world production of antimony from domestic ores. From 1935 to 1941, inclusive, there is no record of any output of the metal from French mines, but smelter output from imported ores continued. During the war years 1940–44 average annual smelter production was 673 tons, largely from Algerian ores. Production from domestic ores was 128 metric tons of estimated recoverable metal in 1942, 153 tons in 1943, and 107 tons in 1944.

Greece.—Undeveloped deposits of antimony minerals have been reported on the islands of Mytilene, Lesbos, and Thassos; in the Othyrus Mountains; and in the hills north of the Gulf of Volo. Some production is known to have been made from the Antoniadès mine near Golgothas in the Department of Serres, Macedonia, and French-owned mines near Keram, on Chios Island.

Honduras.—Small quantities of ore have been exported in recent years from deposits in the Departments of Copan and Olancho. The highest recorded production was in 1943, when 110 metric tons of recoverable metal were exported.

India.—Small deposits of antimony in Chitral and Lahaul (Spiti) have been worked when the price was high but their potential output is insignificant compared with the demand from India's modern industry.

Iran (Persia).—A small but unrecorded output of antimony is made from deposits at Anarak, about 200 miles southeast of Tehran, and at Firdaus (Tourn), about 400 miles east of Tehran. Ore from Anarak is smelted locally, and that from Firdaus is shipped to a smelter at Tehran.

Italy.—Italian production of antimony comes from the islands of Sardinia and Sicily and from deposits in northern Italy. Smelters are located at Vallacides, Sardinia, and Rosia, northern Italy.

Morocco, French.—Small reserves of antimony associated with lead are known to exist in veins in carboniferous schists at Gouard ou Fellous and Tafoudeit. Potential production from these deposits has been estimated at 150 tons of 60-percent concentrates a month, but recorded production from the entire country during the 5-year period 1940–44 averaged only 277 metric tons of recoverable antimony contained in ores and concentrates a year.

Morocco, Spanish.—A small quantity of antimony ore has been shipped to Spanish smelters each year, but this production is decreasing owing to competition from deposits being developed in Spain.

Peru.—The Cerro de Pasco Copper Corp. is the largest producer of antimony in Peru. This output enters trade in the form of bars containing 95 percent antimony. Nearly 100 small operators ship hand-sorted ore from deposits in the Departments of Ancash, Huancaavelica, Huanuco, Junin, La Libertad, Lima, and Puno. Production

decreased 63 percent from 2,472 metric tons of recoverable metal contained in ores and concentrates in 1943 to 914 metric tons in 1944.

Spain.—Normal annual consumption of antimony metal in Spain is 150 to 200 metric tons, and production during the 5-year period 1940-44 averaged 370 tons. This production came mainly from mines at Almuradiel, Ciudad Real Province, and the Villarbacu mines, Lugo Province, although some ore is mined in Coruña, Gerona, and Orense Provinces.

Turkey.—Deposits of stibnite are known near Aydian, in the western part of the country, and Turhal, about 175 miles northeast of Ankara, but as far as is known there was no output during 1944. Production of ore averaged 1,100 metric tons a year from 1936 to 1939 but was of little significance in 1940 and 1941. In 1942, however, 1,449 metric tons were mined and shipped to Germany. Measured reserves of ore at Turhal are reported to be 70,000 metric tons.

Union of South Africa.—More than 5,000 tons of antimony concentrates were produced from gold ores in the Leydsdorp area near Gravelotte station, northern Transvaal, during the fiscal year ended August 30, 1944.

United Kingdom.—No antimony ore is mined in Great Britain or Northern Ireland, but smelter production from imported ores and concentrates gives the United Kingdom an important place in world trade in the metal and its compounds. The antimony supply situation apparently is somewhat better in England than in the United States because all restrictions on buying and selling antimony metal, sulfide, and oxide were lifted, effective February 8, 1945.

Yugoslavia.—Antimony deposits are known in Serbia, Bosnia, and Slovenia, but only those of Serbia are mined. From 1938 through 1940—the last year for which data are available—Yugoslavia was the world's fourth largest producer of antimony.

A recent summary⁴ containing the latest available information is reprinted herewith.

The Stolica mine at Brzitza, 3 miles north of Krupanj, has been in the past the principal producer of antimony in the country. Before the war the mine was owned by Podrinje Mines, Ltd., an English company. The mine, the reserves of which are estimated to be sufficient for a minimum of 10 years at the present rate of mining, produced in 1938 about 12,000 tons of 17-percent antimony ore. The ore is transported by oxcart to the company antimony smelter at Krupanj. This smelter, which had an annual capacity to produce 1,500 tons of antimony metal, was enlarged and modernized in 1938 and its capacity increased to 1,800 tons.

In recent years, the Montania A. G., a German concern, has developed the Zajaca mine about 9 miles northwest of Krupanj and has installed at Loznica a smelter equipped with a Wallis furnace having a monthly capacity of 100 tons of antimony. Reports indicate that 3 to 4 tons of metal are being produced daily.

Four miles northeast of Ivanijica and about 25 miles southwest of Kraljevo is the Lisanski mine, which according to reports has been acquired by German interests. The ore reserves were found large enough to warrant the erection of a smelter capable of producing 900 tons of antimony per year.

⁴ Bureau of Mines, Foreign Minerals Survey: Vol. 1, No. 6, June 1944, pp. 11-12.

CADMIUM

By THOMAS P. WOOTTON AND FRANCES E. CREWS

SUMMARY OUTLINE

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SUMMARY

Cadmium continued to rank high among the critical materials throughout 1944, and close control was maintained by the War Production Board through General Preference Order M-65. Although both production and imports were greater than in 1943, increased military requirements and larger exports caused a net decline in stocks. A new cadmium plant, at the Eagle-Picher Co., Galena, Kans., lead smelter, came into production during the year. The stepped-up rocket program, plus the continued need for cadmium in tank and aircraft parts, precluded any increase in civilian supply. The Office of Price Administration ceiling price remained 90 cents a pound for commercial sticks and 95 cents for patented shapes.

Salient statistics of the cadmium industry in the United States, 1940-44, in pounds

	1940	1941	1942	1943	1944
Production (primary).....	6,363,600	7,233,500	7,370,969	8,406,963	8,779,856
Imports (metal).....	27,491	147,378	53,298	48,891	66,627
Exports.....	387,118	171,858	283,630	169,265	467,202
Consumption.....	6,178,000	7,766,000	7,659,000	7,381,000	8,865,000
Stocks (year-end).....	2,844,200	2,610,643	2,338,638	3,405,809	3,026,940

¹ Revised figure.

DOMESTIC PRODUCTION

Cadmium is essentially a byproduct derived from residues accumulated in the recovery of other metals, and its production is related closely to that of other metals, notably zinc and lead.

In 1944, the sixth successive year of an uninterrupted upward trend, production of primary cadmium exceeded that of the previous year by 4 percent. The increase in production during the war period resulted not only from greatly expanded domestic needs—principally military—but also from the dislocation of the European zinc-smelting industry by the German invasion and occupation of the Low Countries. Zinc concentrates from the Belgian Congo usually went to Belgium for treatment, and in peacetime a large part of the zinc ore from eastern Canada, Australia, South America, and even Mexico was

shipped to European smelters for treatment. To handle this increased smelting burden, domestic capacity has been repeatedly enlarged, and one completely new plant was erected—the American Smelting & Refining Co. refinery at Corpus Christi, Tex. Domestic production of cadmium during the first years of the war was enhanced substantially by treatment of accumulated cadmium-bearing flue dusts, but most of those stocks have been exhausted, and at present most of the output is from current smelting of domestic and imported cadmium-bearing zinc and lead ores.

Cadmium produced and shipped in the United States, 1940-44, in pounds

	1940	1941	1942	1943	1944
Production:					
Primary:					
Metallic cadmium.....	6,154,200	6,937,931	7,323,346	8,396,292	8,453,470
Cadmium compounds (Cd content) ¹ ..	209,400	296,600	47,623	70,671	326,386
Total primary production.....	6,363,600	7,233,500	7,370,969	8,466,963	8,779,856
Secondary (metal and Cd content of compounds) ^{1 2}	227,900	379,500	316,345	162,424	106,850
Shipments by producers:					
Primary:					
Metallic cadmium.....	6,467,260	7,044,417	7,233,043	8,326,768	8,551,424
Cadmium compounds (Cd content) ¹ ..	205,900	265,700	78,059	137,952	285,203
Total primary shipments.....	6,673,200	7,310,100	7,311,102	8,464,720	8,836,627
Secondary (metal and Cd content of compounds) ^{1 2}	227,200	376,500	304,894	187,913	106,850
Value of primary shipments:					
Metallic cadmium.....	\$4,527,082	\$5,498,404	\$5,740,082	\$6,570,546	\$6,435,124
Cadmium compounds.....	144,130	207,246	61,948	108,844	213,902
Total value.....	4,671,212	5,705,650	5,802,030	6,679,390	6,649,026

¹ Excludes compounds made from metal.

² Bureau of Mines not at liberty to publish figures separately for secondary cadmium compounds.

Of the 1944 output 63 percent came from 4 plants in 4 Western States, 30 percent from 11 plants in 7 Central States, and 7 percent from 6 plants in 3 Eastern States. Forty-three percent of the primary metallic cadmium was recovered at electrolytic zinc plants. All electrolytic zinc plants in the United States produce electrolytic cadmium except the Monsanto plant of the American Zinc Co. of Illinois, the residues from which are sent to Fairmont, Ill., for distillation. The Eagle-Picher Co. began production of cadmium at its Galena, Kans., lead smelter and pigment plant in March 1944. This plant derives its cadmium from lead fumes rich in cadmium and from baghouse fumes arising from the roasting of zinc concentrates for sulfuric acid manufacture. This material is treated in leaching and precipitating tanks and a Faber du Faure distilling furnace. The final metal is cast into bars for the market.

A large quantity of the cadmium-compound output is from metal, but some is produced directly from primary residues and secondary metal. Production in 1944 was 39 percent greater than in 1943. In the accompanying table figures on certain compounds are grouped to avoid disclosure of confidential information.

Cadmium compounds produced in the United States, 1942-44, in pounds

Compound	1942		1943		1944	
	Gross weight	Cd content	Gross weight	Cd content	Gross weight	Cd content
Sulfide ¹	1,001,124	300,414	671,831	227,045	1,312,263	466,794
Oxide ²	594,018	519,586	511,382	447,143	539,897	471,845
Nitrate.....	9,710	3,546			10,003	6,981
Hydrate.....	³ 24,207	³ 15,821	⁴ 9,995	⁴ 6,129		
Chloride.....	15,225	7,924	10,973	5,503	18,595	6,303
Carbonate.....	14,012	9,076	6,383	4,044	6,137	3,990
Bromide.....	(⁵)	(⁵)	1,844	598		
Sulfate.....	5,442	2,584	4,790	2,354	14,577	6,381
Iodide.....	1,201	369	(⁶)	(⁶)	3,765	1,357
Acetate.....	948	406	1,892	832		
Total production.....	1,665,887	859,726	1,219,090	693,648	1,906,237	963,651

¹ Includes cadmium lithopone and cadmium sulfoselenide.² In addition to quantities shown, cadmium oxide consumed in making other compounds shown was produced as follows: 1942, 38,721 pounds (Cd content, 33,881 pounds); 1943, 25,975 pounds (Cd content, 22,833 pounds); 1944, 31,469 pounds (Cd content, 27,662).³ Bromide included with hydrate to avoid disclosure of confidential figures.⁴ Iodide included with hydrate to avoid disclosure of confidential figures.FOREIGN TRADE ¹

Total 1944 imports of metallic cadmium and of cadmium contained in flue dust increased 10 percent, and total exports of cadmium metal and cadmium contained in compounds increased 176 percent.

Imports.—Cadmium contained in imported flue dust, all of which came from Mexico, increased 3 percent from 1,643,404 to 1,689,322 pounds, and imports of metallic cadmium increased 36 percent from 48,891 to 66,627 pounds. Imports of metal originated in the Belgian Congo, Italy, and Peru. The receipt of 8,656 pounds of cadmium from Italy in 1944 marked the first imports from that country since 1939, when 35,304 pounds were received. This metal was old stock confiscated by the Allies from a smelter on Sardinia. Imports from Peru began in 1943 but were lower by 43 percent in 1944.

Metallic cadmium imported for consumption in the United States, 1940-44

Country	1940		1941		1942		1943		1944	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Belgian Congo.....					53,298	\$40,363	40,355	\$33,325	53,082	\$50,699
Belgium.....	27,491	\$9,520							8,656	7,790
Canada.....			136,280	\$139,898						
Peru.....							8,536	7,839	4,889	4,495
United Kingdom ¹			11,098	12,166						
	27,491	9,520	147,378	152,064	53,298	40,363	48,891	41,164	66,627	62,984

¹ United Kingdom of Great Britain and Northern Ireland.

Exports.—During 1944 exports of metallic cadmium increased 196 percent from 153,637 to 454,644 pounds, and exports of cadmium contained in compounds decreased 20 percent from 15,628 to 12,558 pounds. Much of this large increase in foreign shipments was accounted for by shipments to Russia. Metal export figures are based

¹ Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

on returns from exporters to the Bureau of Mines, whereas those for compounds in 1944 and 1943 were estimated from data for gross weight obtained from the United States Department of Commerce. In addition to the exports mentioned above, the Commerce Department reported under cadmium exports the shipment to Mexico of 1,343 short tons of "lead-bearing flue dust," but the cadmium content was not given.

CONSUMPTION AND USES

Domestic consumption of cadmium increased 20 percent in 1944 compared with 1943, all of which can be attributed to larger military requirements. Total demand was so much greater than supply that additional stress was laid on use of substitutes, notably zinc. Representatives of the armed services reported to the War Production Board² that they had been able to divert 1,500,000 pounds annually to essential items by utilizing zinc for certain plate finishes.

Consumption of cadmium for electroplating declined 15 percent, but its use in bearings increased 220 percent over 1943. Use of cadmium in solders and other alloys decreased 27 percent and in chemicals and pigments increased 58 percent. Twenty-two percent of the total consumption was for unspecified uses.

Consumption of cadmium in the United States, 1941-44, by uses

Use	1941		1942		1943		1944	
	Pounds	Percent of total	Pounds	Percent of total	Pounds	Percent of total	Pounds	Percent of total
Electroplating.....	4,586,000	59	6,551,000	87	6,481,000	88	5,496,000	62
Bearings.....	1,504,000	19	282,000	4	249,000	3	798,000	9
Solders.....	130,000	2	201,000	3	285,000	4	266,000	3
Other alloys.....	221,000	3	98,000	1	198,000	2	89,000	1
Pigments.....	1,246,000	16	367,000	4	139,000	2	177,000	2
Chemicals.....	79,000	1	50,000	1	29,000	1	89,000	1
Other.....							1,950,000	22
Total.....	7,766,000	100	7,659,000	100	7,381,000	100	8,865,000	100

¹ Includes cadmium for unspecified uses.

Electroplating.—Sixty-two percent of the total United States consumption of cadmium during 1944 was for electroplating. Of this total 95 percent was for military use, mostly the manufacture of aircraft.

Alloys.—Bearings for heavy-duty use consumed 9 percent of the cadmium, solders 3 percent, and other alloys 1 percent. Cadmium is used in solders and fuse metals to lower the melting point.

Compounds.—Use of cadmium in compounds accounted for only 3 percent of the total consumption. The sulfide and sulfoselenide give yellow and red color to paints, inks, rubber, leather, and ceramic products; the oxide, hydrate, chloride, and fluoborate are used in electroplating solutions; and the halides are used in photography.

² Press Release, WFB-7127, Jan. 12, 1945.

STOCKS

Total domestic (including Government) stocks of cadmium on December 31, 1944, showed an 11-percent decrease from the 1943 figure. Stocks of cadmium compounds in the hands of producers and of distributors increased 187 and 72 percent, respectively. Details are given in the accompanying table.

Cadmium stocks at end of year, 1943-44, in pounds

	1943 ¹			1944		
	Metallic cadmium	Cadmium compounds (Cd content)	Total cadmium	Metallic cadmium	Cadmium compounds (Cd content)	Total cadmium
Producers	405,644	22,003	427,647	306,896	63,186	370,082
Compound manufacturers	29,930	91,780	121,710	11,558	63,267	74,825
Distributors ²	410,257	36,570	446,827	358,605	62,766	421,371
Consumers ³	911,000	69,000	980,000	924,483	46,000	970,483
Government	1,429,625	-----	1,429,625	1,190,179	-----	1,190,179
Total stocks	3,186,456	219,353	3,405,809	2,791,721	235,219	3,026,940

¹ Revised figures.

² Comprises principally 6 largest dealers.

³ Partly estimated. Includes some material in process. Excludes stocks of compounds held by pigment and chemical consumers.

PRICES

Office of Price Administration ceiling prices of 90 cents a pound for metallic cadmium sticks and 95 cents a pound for patented shapes prevailed throughout the year. Value of shipments of the metal, as reported to the Bureau of Mines by primary producers, was 75 cents a pound in 1944 compared with 79 cents in 1943 and 1942 and 78 cents in 1941. Producers' quotations, according to E&MJ Metal and Mineral Markets, remained at 90 cents a pound.

Prices for cadmium compounds, as quoted by Oil, Paint and Drug Reporter, were \$1.65 to \$1.91 a pound for cadmium bromide, \$0.85 to \$1 for cadmium lithopone red, \$0.55 to \$0.65 for cadmium lithopone yellow, and \$1.10 for cadmium sulfide.

WORLD PRODUCTION

The following table shows available data for recent years on world production of metallic cadmium and United States production of metallic cadmium and cadmium compounds.

World production of cadmium, 1938-44, by countries, in kilograms

[Compiled by B. B. Waldbauer]

Country	1938	1939	1940	1941	1942	1943	1944
Australia (Tasmania)	199, 326	175, 150	175, 232	194, 975	165, 821	160, 100	253, 972
Belgian Congo				3, 086	27, 387	23, 094	(¹)
Belgium	182, 000	² 530, 800	(¹)	(¹)	(¹)	(¹)	(¹)
Canada	317, 122	426, 234	411, 917	567, 573	521, 158	356, 804	248, 546
France	116, 000	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Germany	432, 000	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Italy	181, 530	146, 417	(¹)	(¹)	(¹)	(¹)	(¹)
Japan	³ 30, 000	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Mexico ⁴	762, 398	816, 584	815, 734	906, 577	854, 264	801, 992	701, 010
Norway	207, 667	138, 000	(¹)	(¹)		(¹)	(¹)
Peru					2, 131	3, 653	2, 174
Poland	182, 591	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
South-West Africa ⁴	259, 133	82, 155	89, 634	⁵ 179, 597	(¹)	(¹)	(¹)
U. S. S. R.	⁶ 50, 000	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
United Kingdom	124, 898	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
United States:							
Metallic cadmium	1, 849, 722	2, 001, 026	2, 791, 484	3, 146, 976	3, 321, 797	3, 808, 474	3, 834, 409
Cadmium compounds							
(Cd content)	98, 200	171, 900	95, 000	134, 000	21, 600	32, 100	148, 045
	3, 971, 100	4, 300, 000	4, 800, 000	(¹)	(¹)	(¹)	(¹)

¹ Data not available; in 1939 and 1940, estimate included in total. ² Exports. ³ Estimate.⁴ Cadmium content of flue dust exported for treatment elsewhere; represents in part shipments from stocks on hand. To avoid duplication of figures, the data are not included in the total.⁵ Figures cover January to June, inclusive.

REVIEW BY COUNTRIES

Australia.—The Electrolytic Zinc Co. of Australasia, Ltd., reported the production of approximately 200 tons of cadmium from zinc concentrates and lead-furnace baghouse fumes. Prior to 1944 about 60 percent of this output was used by Australian industry, but beginning in 1944 more than half of it was exported to England.

Belgian Congo.—Thirteen metric tons of cadmium were produced during the year by "Sogechim", a subsidiary of Union Minière du Haut-Katanga, from zinc concentrates. This plant, a wartime installation, first reported production in 1941.

Canada.—Canadian output of cadmium comes from the Trail, British Columbia, plant of the Consolidated Mining & Smelting Co. of Canada, Ltd., and the Flin Flon, Manitoba, plant of the Hudson Bay Mining & Smelting Co., Ltd. Zinc ores from British Columbia furnished 75 percent of the metal, 22 percent came from Saskatchewan, and the remainder from Manitoba.

Italy.—More than 4 tons of metallic cadmium were imported into the United States from the electrolytic zinc plants on Sardinia, occupied by Allied forces in 1943.

Mexico.—Flue dust containing cadmium is recovered at the San Luis Potosí, Rosita, and Chihuahua smelters of the American Smelting & Refining Co. and at the Monterrey and Torreon smelters of the American Metal Co., Ltd., and shipped to the United States for refining.

Norway.—During prewar years Det Norske Zinkkompani annually produced about 150 tons of cadmium at its electrolytic zinc plant near Bergen, using zinc calcines from Belgium. In the first 5 months of 1944 the output was only 4 metric tons.

Peru.—Cadmium was produced by the Cerro de Pasco Copper Corp. at its Oroya smelter.

PLATINUM AND ALLIED METALS

By HUBERT W. DAVIS AND GERTRUDE N. GREENSPOON

SUMMARY OUTLINE

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SUMMARY

Although there was no critical shortage of platinum metals in 1944, supplies of platinum, iridium, osmium, and rhodium were not adequate to permit their use for nonessential purposes.

Salient statistics of platinum and allied metals in the United States, 1943-44, in troy ounces

	1943	1944		1943	1944
Production:			Stocks in hands of refiners, importers, and dealers, Dec. 31:		
Crude platinum from placers.....	27, 162	33, 625	Platinum.....	176, 560	159, 173
New metals:			Palladium.....	104, 372	123, 448
Platinum.....	234, 320	132, 452	Other.....	42, 081	39, 866
Palladium.....	82, 441	10, 966		323, 013	322, 487
Other.....	18, 495	9, 627	Imports for consumption:		
	335, 256	153, 045	Unrefined materials.....	263, 968	137, 192
Secondary metals:			Refined metals.....	98, 283	219, 020
Platinum.....	68, 613	94, 764		362, 251	356, 212
Palladium.....	23, 616	32, 427	Exports:		
Other.....	9, 352	4, 710	Ore and concentrates.....	84	70
	101, 581	131, 901	Refined metals and alloys, including scrap.....	1, 381	6, 257
			Manufactures (except jewelry).....	1, 802	2, 387

Refining of platinum in the United States was not only substantially less than in 1943, but it was insufficient for military and essential civilian requirements. The deficiency, however, was met by larger imports of refined metal and by the release of some Government stocks. Consumption (as measured by sales) of platinum declined 20 percent from the all-time record established in 1943. The drop was largely because in 1943 a substantial proportion of the platinum sold went into capital installations in the form of spinnerets for glass fiber and rayon and for laboratory ware. Despite the fact that in 1944 only 43,393 ounces of palladium were refined in the United States,

whereas domestic sales were 154,339 ounces, there was no problem in connection with supplies, because stocks were large. Both refining and sales of the other platinum metals—iridium, osmium, ruthenium, and rhodium—were comparatively small in 1944; nevertheless, refining of the first three of these metals did not equal demand. The deficit, however, was met by imports of refined metals. Enough rhodium was refined to fill demands.

In July 1944 the War Production Board freed iridium from direct allocation under Conservation Order M-49, but consumption remained limited to permitted uses. Larger supplies and reduced demand brought a price reduction in iridium in July from \$165 an ounce to \$120, where it remained the rest of 1944. Restrictions on the use of palladium in jewelry, as provided for in Order L-45 of WPB, were lifted in August.

Figure 1 shows graphically the trend in world production of platinum metals from 1914 to 1944.

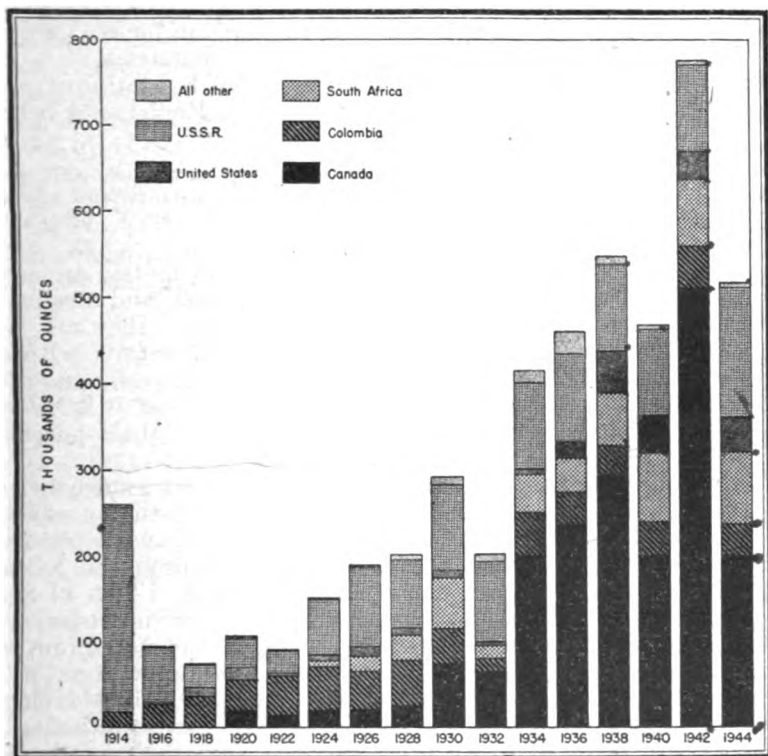


FIGURE 1.—Trend in world production of platinum metals, 1914-44.

POSTWAR OUTLOOK

In appraising the postwar outlook for the platinum metals it is believed appropriate to review briefly the industry since 1930.

During the decade 1930-39 the world production of platinum metals increased from about 290,000 ounces in 1930 to 540,000 ounces in 1939. Concurrently, Canadian production of platinum metals advanced from 68,116 ounces to 284,304 ounces, as a result of the higher byprod-

uct output in Canada, where the platinum-group metals are found associated with the nickel-copper ores of the Sudbury district, Ontario. To absorb this greatly expanded output, research to find new uses was pursued with great energy and pronounced success, with the result that larger, more diversified markets were opened. Also, much attention was given to reviving old ways of utilizing the platinum metals. Meanwhile, the lower and more stable price of the platinum metals helped them to compete successfully with substitutes. As a consequence of these developments, consumption of the platinum metals has likewise increased phenomenally, and although exact information is not available it is believed that the bulk of the metals produced during 1930-39 was also marketed.

The war emphasized the importance and versatility of the platinum metals; accordingly, consumption has increased further. Despite prohibitions and limitations on the use of certain platinum metals for nonessential purposes, consumption (as measured by sales) in the United States advanced from 206,890 ounces in 1940 to 509,232 ounces in 1943. Much of this gain was due to the demand for platinum for electronic tubes, contact points, spark plugs, and catalysts.

Although a decline in domestic consumption of the platinum metals is expected with the ending of World War II, Englehard¹ believes that:

Much of what is being learned during the war concerning the uses and advantages of platinum metals will be applicable to post-war products and processes, which supports a confident view of the long-term possibilities of the platinum industry.

Although certain peacetime markets for platinum metals are necessarily restricted by their cost, the chemical, physical, and mechanical properties of these metals are so extraordinary that they are being used more and more for industrial purposes. Therefore, with stability in the price that will permit their continued use for industrial purposes, plus aggressive research to find further uses, it is believed that the platinum metals will expand steadily in their peacetime applications:

No new important deposits of platinum metals are known to have been discovered during recent years; consequently, future production will continue to come from established sources. Canada most certainly will maintain its predominant position as a producer, followed chiefly by the Union of Soviet Socialist Republics, Union of South Africa, Colombia, and Alaska, but not necessarily in that order.

Stable prices on platinum, palladium, rhodium, and ruthenium have prevailed for several years. As lower and stable quotations on the platinum-group metals have been an important factor in developing larger and more diversified markets, it is likely that most of the leading producers will favor a steady price policy. Nevertheless, when the restriction on the sale and use of platinum for jewelry and decorative use is removed by the War Production Board, it is possible, because of the accumulated demand for this metal by the jewelry trade, that there might be a short-lived price advance. No material price change is foreseen for palladium, osmium, rhodium, and ruthenium. Iridium, however, is more sensitive to supply and demand rumors and to speculation than any of the other platinum metals and as in the past probably will be subject to sporadic fluctuations in price.

¹ Englehard, Charles, *The Platinum Metals in 1944*: Am. Metal Market, vol. 82, No. 7, Jan. 11, 1945, p. 81

CRUDE PLATINUM

Production.—Mine returns for 1944 show a production of 33,616 ounces of crude platinum in Alaska and 9 ounces in Montana—a total of 33,625 ounces; comparable figures for 1943 are 27,100 ounces of crude platinum in Alaska and 62 ounces in California—a total of 27,162 ounces. Production in Alaska in 1944 came from placer deposits in the Goodnews Bay district of southwestern Alaska, which were mined by a large modern dredge and by well-mechanized draglines. The output in Montana was a byproduct of a dredge working a gold placer in the Missouri River district, Lewis and Clark County. There was no production of platinum in California and Oregon in 1944 because the gold dredges which formerly worked platinum-bearing gravels were idle under War Production Board Order L-208.

Many gold and copper ores in the United States contain small quantities of platinum metals. In 1944, 6,924 ounces of platinum metals were recovered as byproducts of refining gold and copper ores compared with 10,390 ounces in 1943.

Purchases.—Buyers in the United States reported purchases of domestic crude platinum from the following sources in 1944: Alaska, 33,457 ounces; California, 379 ounces; and Oregon, 5 ounces—a total of 33,841 ounces (28,130 ounces in 1943). Domestic buyers also reported purchases of 29,700 ounces (39,409 ounces in 1943) of foreign crude platinum from Colombia in 1944.

Prices.—Buyers reported purchases at \$26.25 to \$37.51 an ounce for domestic and foreign crude platinum in 1944. This price range resulted chiefly from variations in iridium content of crudes rather than from market fluctuations for refined platinum metals.

REFINED PLATINUM METALS

New metals recovered.—Reports from refiners of crude platinum, gold bullion, nickel, and copper indicate that 153,045 ounces of platinum metals were recovered in the United States from such sources in 1944—a decrease of 54 percent from 1943. Of the new metals recovered in 1944, 78 percent was chiefly from concentrates from Canada and crude from Colombia, 17 percent from domestic crude (chiefly from Alaska), and 5 percent a byproduct of domestic gold and copper ores.

New platinum metals recovered by refiners in the United States in 1944, by sources, in troy ounces

	Plati- num	Palladi- um	Iridium	Osmium	Rhodi- um	Ruthe- nium	Total
Domestic from—							
Crude platinum.....	22,182	143	3,201	456	111	4	26,097
Gold and copper refining...	3,286	3,575	32	7	20	4	6,924
	25,468	3,718	3,233	463	131	8	33,021
Foreign from—							
Crude platinum.....	106,984	7,248	1,173	-----	3,125	1,494	120,024
Nickel and copper refining							
Total recovery.....	132,452	10,966	4,406	463	3,256	1,502	153,045

New platinum metals recovered by refiners in the United States, 1940-44, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1940.....	38,951	4,564	1,517	2,307	47,339
1941.....	98,376	49,812	1,392	3,043	152,623
1942.....	244,226	140,262	5,102	10,737	400,327
1943.....	234,320	82,441	5,296	13,209	335,256
1944.....	132,452	10,966	4,406	5,221	153,045

Secondary metals recovered.—In 1944, 131,901 ounces of secondary platinum metals were recovered from the refining of scrap metal, sweeps, and other waste products of manufacture that contain platinum metals—a 30-percent increase over 1943.

Substantial quantities of worn-out catalysts, spinnerets, laboratory ware, and other products are returned by customers to refiners for refining. The refined platinum metals recovered from these products (or their equivalent in refined metals) are returned to the customers. The platinum metals so recovered are not included in the statistics of secondary metals.

Secondary platinum metals recovered in the United States, 1940-44, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1940.....	47,657	14,773	1,365	2,635	66,430
1941.....	37,522	12,630	659	758	51,569
1942.....	56,150	18,416	1,552	2,493	78,611
1943.....	68,613	23,616	2,771	6,581	101,581
1944.....	94,764	32,427	1,348	3,362	131,901

Prices.—Maximum prices for the six platinum metals, fixed by the Office of Price Administration on February 1, 1943, remained in effect in 1944. The maximum prices per troy ounce for refined metals of a commercial purity of at least 99.5 percent were as follows: Platinum, \$35; palladium, \$24; iridium, \$165; osmium, \$50; rhodium, \$125; and ruthenium, \$35.

Except for iridium, prices for the platinum-group metals remained stable in 1944. However, iridium, which was quoted at \$165 an ounce until July, was reduced to \$120, where it remained for the balance of 1944.

Properties and uses.—Much information on the platinum metals and their alloys, particularly their physical and mechanical properties and their many and diverse uses, is given in the comprehensive book, *The Platinum Metals and Their Alloys*, published in 1941 by the International Nickel Co., Inc., New York, N. Y. A tabulation of uses of the platinum metals is given in the chapter of this series for 1943.

Consumption.—As pure metals, combined, clad, or alloyed with other metals, the platinum metals are employed in the electrical and chemical industries, in dentistry and jewelry, and for numerous miscellaneous purposes. Sales to consumers in the United States were 452,204 ounces in 1944 compared with 509,232 ounces in 1943.

The most widely used metal of the group is platinum, which constituted 275,648 ounces (61 percent) of the total platinum metals sold to consumers in the United States in 1944. By taking 64 percent of the

total platinum sold, the electrical industry was again the chief buyer, but sales to it were 4 percent less than in 1943. The largest outlets for platinum in the electrical industry were for magneto and other contacts, electronic tubes, and spark plugs. Sales for contact points and electronic tubes were 24 and 34 percent, respectively, smaller than in 1943. However, sales of platinum for spark plugs—a new use—were 44,500 ounces in 1944. The chemical industry was the second-largest buyer of platinum in 1944, but its purchases were 54 percent less than in 1943. Nevertheless, it accounted for 60,936 ounces (22 percent) of the total sales. The decline was mainly because in 1943 a substantial amount of the platinum sold went into capital installations in the form of spinnerets for glass fiber and rayon and for laboratory ware. Sales of platinum for dental and medical uses again increased and accounted for 34,783 ounces (13 percent) of the total sold. Because of the ban on sale and use of platinum in the manufacture of jewelry, only 424 ounces were sold to the jewelry industry in 1944, presumably for repair work. Before World War II the jewelry industry absorbed over half of the platinum sold in the United States.

Next to platinum, palladium is the most extensively used metal of the group; it constituted 154,339 ounces (34 percent) of the total platinum metals sold to domestic consumers in 1944. The jewelry industry was again the largest outlet for palladium and took 56,558 ounces (37 percent) of the total palladium sold in 1944. Sales of palladium to the jewelry industry were 25 percent greater than in 1943. The electrical industry, which dropped from first to third place as a buyer of palladium in 1943, advanced to second place in 1944; it accounted for 42,322 ounces (27 percent) of the total sold. The dental trade was the third largest outlet for palladium in 1944, taking 36,377 ounces (24 percent) of the total sold. Sales of palladium to the chemical industry (9,673 ounces) were 32 percent less than in 1943. The pen and pencil trade became an important consumer of palladium for precious metal nibs and other parts in 1944.

The consumption of the other platinum metals—iridium, osmium, rhodium, and ruthenium—was comparatively small; it made up 5 percent (22,217 ounces) of the total for the group in 1944. Ruthenium and iridium were the most extensively used metals of this group, followed in order by rhodium and osmium. Sales of each of these metals were less than in 1943, but the decline for osmium was more pronounced than for the other metals.

The following table shows sales of platinum metals by refiners, importers, dealers, and Metals Reserve Company to consumers in the United States in 1944.

Platinum metals sold to consuming industries in the United States in 1944, in troy ounces

Industry	Platinum	Palladium	Iridium, osmium, rhodium, and ruthenium	Total
Chemical.....	60,936	9,673	3,944	74,553
Electrical.....	178,038	42,322	11,650	232,010
Dental and medical.....	34,783	36,377	177	71,337
Jewelry.....	424	56,558	2,847	59,829
Miscellaneous and undistributed.....	1,467	9,409	3,599	14,475
	275,648	154,339	22,217	452,204

Stocks.—Stocks of platinum metals in all forms in the hands of refiners, importers, and dealers totaled 322,487 ounces on December 31, 1944, compared with 323,013 ounces at the close of 1943.

Stocks of platinum metals held by refiners, importers, and dealers in the United States, December 31, 1940-44, in troy ounces

Year	Platinum	Palladium	Iridium, osmium, rhodium, and ruthenium	Total
1940.....	144,302	93,244	32,368	269,914
1941.....	150,887	138,014	33,942	322,843
1942.....	160,724	107,383	35,280	303,387
1943.....	176,560	104,372	42,081	323,013
1944.....	159,173	123,448	39,866	322,487

FOREIGN TRADE²

Imports.—After increasing for three successive years to establish a new record in 1943, imports of platinum metals declined slightly in 1944. The principal sources of imported platinum metals in 1944 were Canada (223,008 ounces), U. S. S. R. (75,322 ounces), Colombia (35,320 ounces), and United Kingdom (22,553 ounces). Imports of unrefined materials (137,192 ounces) were 48 percent less than in 1943, but imports of refined metals (219,020 ounces) were 123 percent more. Imports of refined platinum, palladium, and iridium were 70, 213, and 191 percent, respectively, greater than in 1943, but imports of ruthenium were 39 percent less.

Platinum metals (unmanufactured) imported for consumption in the United States, 1943-44

Material	1943		1944	
	Troy ounces	Value	Troy ounces	Value
Unrefined materials: ¹				
Ores and concentrates of platinum metals.....	92,709	\$2,829,164	101,747	\$2,993,639
Grains and nuggets (including crude, dust, and residues).....	98,401	2,884,542	35,345	1,014,169
Sponge and scrap.....	72,783	2,218,706	65	1,690
Osmiridium.....	75	5,054	35	2,593
	263,968	7,937,466	137,192	4,012,091
Refined metals:				
Platinum.....	41,272	1,545,975	70,150	2,631,546
Palladium.....	43,874	932,392	137,496	3,116,904
Iridium.....	1,056	133,342	3,075	597,159
Osmium.....	1,161	47,386	1,345	71,654
Rhodium.....	405	45,989	504	47,044
Ruthenium.....	10,515	293,693	6,450	197,890
	98,283	2,998,777	219,020	6,662,197
	362,251	10,936,243	356,212	10,674,288

¹ The concentrates and crude imported from Canada contain platinum, palladium, iridium, rhodium, and ruthenium, and the crude sponge imported from Canada contains platinum and palladium. Although the U. S. Department of Commerce records "platinum content" for these entries, the Bureau of Mines has determined from the importers of these materials that most of the entries reflect the platinum metals content. The Bureau of Mines has also determined from the largest importer of crude platinum from Colombia that the entries for his material, recorded as "platinum content" by the U. S. Department of Commerce, represent the gross weight of the material.

² Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Platinum metals (unmanufactured) imported for consumption in the United States, 1943-44, by countries, in troy ounces

Country	Unrefined materials ¹				Refined metals					Total
	Ores and concentrates of platinum metals	Grains and nuggets (including crude, dust and residues)	Sponge and scrap	Osmiridium	Platinum	Palladium	Iridium	Osmium	Rhodium and ruthenium	
1943										
Canada	92,709	60,169	72,686	-----	(?)	32,137	(?)	11	5,895	263,607
Colombia		38,232		-----						38,232
U. S. S. R.				61	41,272	11,737	1,056	1,150	5,025	41,272
United Kingdom ² ..			97	14						19,029
Other countries										111
	92,709	98,401	72,783	75	41,272	43,874	1,056	1,161	10,920	362,251
1944										
Canada	101,747	29	52	14	130	118,532	(?)	-----	2,504	223,008
Colombia		35,316	4	-----						35,320
U. S. S. R.				-----	70,020	3,212	2,090	-----		75,322
United Kingdom ² ..				21		15,752	985	1,345	4,450	22,553
Other countries			9	-----						9
	101,747	35,345	65	35	70,150	137,496	3,075	1,345	6,954	356,212

¹ See footnote 1 of preceding table.

² Less than 1 ounce.

³ United Kingdom of Great Britain and Northern Ireland.

Platinum metals imported for consumption in the United States, 1940-44 ¹

Year	Troy ounces	Value	Year	Troy ounces	Value
1940	195,645	\$5,748,005	1943	362,251	\$10,936,243
1941	309,995	7,143,612	1944	356,212	10,674,288
1942	315,002	11,306,565			

¹ See footnote 1 of preceding table.

Exports.—Exports of refined platinum metals and alloys (including scrap) increased to 6,257 ounces in 1944 from 1,381 ounces in 1943. Canada and Brazil were the chief foreign markets for platinum metals in 1944.

Platinum and allied metals exported from the United States, 1940-44

Year	Ore and concentrates		Platinum (bars, ingots, sheets, wire, sponge, and other forms, including scrap)		Palladium, rhodium, iridium, osmiridium, ruthenium and osmium (metal and alloys, including scrap)		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value
1940.....	(1)	(1)	55,027	\$2,280,339	(2)	(2)	1,800	\$96,703
1941.....	244	\$11,713	15,405	607,333	(2)	(2)	3,204	160,674
1942.....	159	6,581	3,354	126,007	99,107	\$2,301,953	1,246	61,088
1943.....	84	3,642	890	43,961	521	28,264	1,802	70,226
1944.....	70	224	1,243	52,014	5,014	388,930	2,387	99,356

¹ Not separately classified.² Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium included with platinum; not separately classified before 1942.*Platinum and allied metals exported from the United States, 1943-44, by countries*

Year	Ore and concentrates		Platinum (bars, ingots, sheets, wire, sponge, and other forms, including scrap)		Palladium, rhodium, iridium, osmiridium, ruthenium and osmium (metal and alloys, including scrap)		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value
1943								
Argentina.....			113	\$4,902				
Australia.....					84	\$2,061	17	\$825
Brazil.....	71	\$3,246	115	4,511	12	610	40	691
Canada.....	4	74	467	26,016	166	16,447	1,341	56,890
Chile.....			6	269	(1)	1,613	27	1,086
Cuba.....	9	322	35	1,144	116	2,792	17	380
Palestine and Trans-Jordan.....					80	2,772	20	693
Other countries.....			124	7,119	63	1,969	340	9,661
	84	3,642	890	43,961	521	28,264	1,802	70,226
1944								
Argentina.....			30	1,080	197	7,156	3	280
Brazil.....			509	20,653	740	22,083	190	11,185
Canada.....			468	21,903	3,460	343,000	1,736	69,647
Colombia.....	70	224	3	120	141	3,763	2	332
Cuba.....			22	555	111	2,983	5	381
Mexico.....			2	73	170	4,766	55	2,257
Uruguay.....			16	628	160	4,136	(1)	23
Other countries.....			193	6,972	35	1,043	396	15,251
	70	224	1,243	52,014	5,014	388,930	2,387	99,356

¹ Less than 1 troy ounce**WORLD PRODUCTION**

Because of restriction on the publication of statistics by certain Governments, production figures for many countries have not been available since 1939.

World production of platinum and allied metals, 1938-44, in troy ounces

[Compiled by B. B. Waldbauer]

Country and product	1938	1939	1940	1941	1942	1943	1944
Australia:							
New South Wales: Placer platinum.....	8	7	12	23	2	3	(1)
Tasmania: Placer osmiridium.....	191	283	465	207	142	90	107
Belgian Congo: From refineries:							
Palladium.....	1,575	3,312	(1)	(1)	(1)	(1)	(1)
Platinum.....	225	868	(1)	(1)	(1)	(1)	(1)
Canada:							
Placer platinum.....	16	25	24	00	30	219,713	155,700
From refineries: ¹							
Platinum.....	161,310	148,877	108,464	124,257	285,198		
Other platinum metals.....	130,893	135,402	91,522	97,432	222,573	126,004	45,100
Colombia: Placer platinum (exports).....	34,549	39,070	35,859	37,349	49,163	39,961	36,136
Ethiopia: Placer platinum.....	3,537	(1)	(1)	(1)	(1)	(1)	(1)
Italy: From refineries: Platinum.....	1,029	1,608	(1)	(1)	(1)	(1)	(1)
Japan: Placer platinum.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Netherlands Indies (probably placer platinum).....	21	25	34	(1)	(1)	(1)	(1)
New Zealand: Placer platinum.....	1	13		35	21	5	21
Panama: Placer platinum.....				(1)	(1)	(1)	(1)
Papua:²							
Placer platinum.....	41	2	(1)	5	(1)	(1)	(1)
Placer osmiridium.....	4	4	(1)	(1)	(1)	(1)	(1)
Sierra Leone: Placer platinum.....	180	83	135	21	(1)	(1)	(1)
Union of South Africa:							
Platinum (content of platinum metals) ⁴	18,256	18,068	20,140	16,580	20,065	18,236	⁵ 9,243
Concentrates (content of platinum metals) ⁴	35,124	41,243	51,835	69,150	53,190	40,654	⁵ 28,604
Osmiridium ⁴	5,354	7,031	(1)	(1)	(1)	(1)	6,896
U. S. S. R.: Placer platinum ¹ ((estimate)).....	100,000	100,000	100,000	100,000	100,000	125,000	150,000
United States:							
Placer platinum.....	40,932	32,480	33,800	26,221	23,213	27,162	33,625
Ore (content of platinum metals).....	90	66		15	26		
From refineries: ¹							
Platinum.....	3,761	5,270	4,470	1,805	4,333	5,205	3,286
Other platinum metals.....	3,486	3,364	3,304	4,689	5,472	5,185	3,638
Total (estimate).....	641,000	540,000	465,000	483,000	773,000	619,000	(1)

¹ Data not available.² Recovered from nickel-copper mattes.³ Year ended June 30 of year stated.⁴ Produced from platinum ores.⁵ January to June, inclusive.⁶ Produced from treatment of gold ores on the Rand.⁷ New platinum metals recovered in gold and copper refining of domestic materials.**REVIEW BY COUNTRIES**

Canada.—According to the Dominion Bureau of Statistics, production of platinum metals from the nickel-copper ores of the Sudbury district, plus an insignificant quantity from placers in British Columbia, was 155,700 ounces of platinum and 45,100 ounces of other platinum-group metals in 1944, compared with 219,713 ounces of platinum and 126,004 ounces of other platinum-group metals in 1943. Production of platinum metals in 1944 was the smallest since 1940. However, the decline in 1944 is more apparent than real, because the reported outputs represent the metals refined from Canadian concentrates at Acton, England, plus the platinum-metals content of concentrates sold, rather than the metals contained in the concentrates actually recovered.

Colombia.—Colombia exported 36,136 ounces of crude platinum in 1944 (39,961 in 1943). The South American Gold & Platinum Co. produced 22,615 ounces of crude platinum metals in 1944 (23,945 in 1943) and 56,097 ounces of crude gold (55,446 in 1943). The production figures for other operators are not available.

TITANIUM

By C. E. NIGHMAN AND R. LOUISE BRYSON

SUMMARY OUTLINE

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GENERAL STATEMENT

Domestic titanium ore output in 1944 entered new high ground nearly 40 percent above the 1943 level. Ilmenite imports rose in the same ratio, but entries of rutile were lower. Consumption of ilmenite made another record, about 20 percent greater than the record of 1943 owing to capacity operation of pigment plants. The use of rutile, however, declined in keeping with the recession in welding-rod production, its principal use. Inventories of titanium concentrates increased nearly one-third during the year but barely kept pace with the expanding use rate. Prices of titanium ores and products remained unchanged.

Existent wartime use controls, principally relating to titanium dioxide, remained essentially unchanged. Military and other preferred uses took approximately 70 percent of pigment production and accounted for nearly 90 percent of rutile consumption.

The United States Department of Justice in June 1944 sought to enjoin the National Lead Co., its subsidiary, Titan Co., Inc., and E. I. DuPont de Nemours & Co. from continuing an international network of patent and marketing agreements that were stated to be in violation of the Sherman Antitrust Act.¹ The case was being tried in District Court for the Southern District of New York in March 1945.

POSTWAR OUTLOOK

The astonishing rate of growth in the over-all use of titanium (ores) in the past 2 decades probably will persist for several years. Roughly 90 percent of the titania used emerges in the form of pigments and most of the remainder as constructional and metallurgical materials. No substantial change in the use pattern is anticipated, although the order of importance of the last two named may be reversed. The supply of pigments has not met demand during the war despite existing plants operating at capacity; currently only about one-third of the production is available for civilian use or roughly one-half the immediate prewar quantity. There is thus a large ac-

¹ U. S. Department of Justice, Press Release: June 24, 1944. See also Titanium chapter, *Minerals Yearbook*, 1943, p. 807.

cumulated demand that represents deferred maintenance in the form of paints, floor coverings, coated textiles, and other materials that make up three-quarters or more of pigment use. Likewise, the construction of new buildings has been almost at a standstill. Direct and indirect military uses have absorbed two-thirds or more of available supply with the major part going to ships—naval and merchant. The construction of new vessels probably will cease abruptly, but the maintenance of the world's largest navy and a large merchant marine will require several times as much marine paint as heretofore. Consumption of titanium pigments in other fields has tended to increase in quantity, and it is believed that their relative share will not change notably. Furthermore, recent developments of improved types of titanium dioxide are expected to extend its usefulness as a white pigment.

As a constructional material titania has become nearly indispensable as a welding-rod coating. The output of titanium dioxide-coated rods more than trebled from 1941 to 1943 (the peak) as a result of the vast increase in welding in military construction and repair. Again, naval application predominated and is hence likely to be cut heavily. However, progress in the use of welding has been so great during the war that much of the gain will be translated to peacetime uses. Consumption of titanium in welding rods is likely, therefore, to fall off considerably but to remain well above the prewar level.

The situation in the metallurgical field is much the same as in that of construction. In general, titanium use will approximately parallel the steel-production trend. There is some likelihood, however, that it may have a steeper slope because of wartime developments in the production and use of ordinary and alloy steels and the cemented carbides.

On the whole, needs for titanium in the nearby future point toward a demand level higher than the present. More distantly there will be a leveling off, but probably requirements may remain near wartime levels.

The future of domestic production of titanium ores is less clear-cut. It is primarily related to the ability to obtain byproduct ilmenite at a cost comparable with that of higher-grade foreign material. Much of that production likewise hinges on the market for magnetite, the major component of the principal ores. At least to the end of the war production will be well maintained. Subsequently a sizable decline is probable, but total domestic output will hold well above prewar figures and for the long term may be expected to rise substantially.

DOMESTIC PRODUCTION

In 1944 production of ilmenite rose 37 percent above that of 1943, and output of rutile climbed 74 percent. All producers of ilmenite made substantial increases, whereas the great gain in rutile output resulted virtually from the operation of the Humphreys Gold Corp. Ilmenite concentrate shipments in 1944 contained 44 to 59 percent TiO_2 , and rutile concentrates 92 to 94 percent TiO_2 .

Arkansas.—The Magnet Cove Rutile Co., successor to Titanium Alloy Co. of Arkansas, at Malvern, Magnet Cove district, Hot Spring County, produced rutile concentrate in the first 7 months of 1944. A water shortage restricted mill operation. There has been some output in nearly every year since Arkansas production was first reported in 1932. Shipments of rutile (85–95 percent TiO_2) totaled 4,246 short tons to the end of 1943. A second grade (55–60 percent

TiO₂) had also been prepared but found no market. The ore contains 3 percent rutile on the average and 4 percent total TiO₂. Part of the titania, however, is locked up in magnetite or alteration products, and recovery is low. About 10 years ago the Bureau of Mines showed that a high-grade product could be made by flotation. Recent operations have been described.²

Production and mine shipments of titanium concentrates from domestic ores in the United States, 1940-44

Year	Ilmenite				Rutile			
	Production (short tons)	Shipments			Production (short tons)	Shipments		
		Gross weight (short tons)	TiO ₂ content (short tons)	Value		Gross weight (short tons)	TiO ₂ content (short tons)	Value
1940.....	20,668	20,702	9,505	\$183,686	2,888	2,657	2,475	\$393,243
1941.....	23,297	21,526	9,930	196,522	3,130	3,431	3,192	493,782
1942.....	77,208	93,397	41,328	1,805,823	2,648	2,649	2,466	410,956
1943.....	203,551	211,715	94,283	3,738,970	3,987	3,941	3,639	610,879
1944.....	278,610	280,791	128,095	7,371,279	6,922	6,770	6,312	1,088,112

Florida.—The Humphreys Gold Corp., operating under lease from the Rutile Mining Co. of Florida and its parent company, the Titanium Alloy Manufacturing Co., produced rutile and ilmenite during 1944 from a 500-acre tract 8 miles east of Jacksonville. Between 4,000 and 5,000 short tons of ancient beach sand were treated daily; and monthly shipments of rutile and ilmenite totaled around 300 tons and 2,000 tons, respectively.³ Humphreys Gold Corp. moved its entire plant and equipment, formerly used in recovering chromite from ancient beach sands in Coos County, Oreg., to the Florida location and began operations there on April 1, 1944. This plant and operation have been described.⁴ Riz Mineral Co. produced ilmenite, rutile, and zircon concentrates from sands taken from dunes near Vero Beach, Indian River County. The concentrator is at Melbourne, Brevard County.

New York.—At Tahawus, New York, the National Lead Co. produced approximately 200,000 tons of ilmenite from about 1,000,000 tons of ore milled in 1944. All the ilmenite was shipped directly to pigment-producing plants.⁵ A magnetic cobber installed in the crushing plant rejects 10 to 20 percent of the crude ore as a tailing low in ilmenite and magnetite and thus increased the mill concentrate output. This and other minor operating improvements were the main factors contributing to the increase in 1944 over the 165,000 short tons produced in 1943. The manpower shortage continued and prevented attainment of the goal of 900 short tons of ilmenite concentrates daily—a goal set the year before to be reached by mid-1944.

North Carolina.—The Yadkin Valley Ilmenite Co., subsidiary of the Glidden Co., produced about 15,000 short tons of ilmenite at Finley, Caldwell County, in 1944, the concentrates averaging 49 percent TiO₂.

² Vogel, Felix A., Jr., Mining and Milling Operations of Rutile Mine of the Titanium Alloy Co. of Arkansas, Hot Spring County, Ark.: Bureau of Mines Inf. Circ. 723, September 1944, 7 pp.

³ Engineering and Mining Journal, Florida Plant Produces Rutile and Ilmenite: Vol. 145, No. 10, October 1944, p. 122.

⁴ Humphreys, I. B., and Hubbard, Judson S., Where Spirals Replaced Tables, Flotation Cells: Eng. and Min. Jour., vol. 146, No. 3, March 1945, pp. 82-84.

⁵ Linney, J. R., Eastern Magnetite: Min. and Met., vol. 26, No. 458, February 1945, pp. 96-97.

Virginia.—Rutile and ilmenite were produced near Roseland, Nelson County, by the American Rutile Corp., subsidiary of the Metal & Thermit Corp. The Virginia Chemical Corp., a producer of ilmenite in the same district, sold its chemical plant property in July 1944 to the Calco Chemical Division of the American Cyanamid Co. In March 1945 the mine and mill were taken over by the same company, so that now Calco Chemical Division, American Cyanamid Co., owns and operates the mine, mill, and chemical plant at Piney River, Nelson County.

FOREIGN TRADE ⁶

Imports.—The Allied successes in 1944 opened all sea routes and permitted India rapidly to expand ilmenite mining that had been dormant since Pearl Harbor; exports to the United States in 1944 were about seven times those of 1943. Brazilian imports were at a high point, and Ceylon appeared for the first time as a supplier. War-expanded imports from Canada were cut to half those of 1943 as other higher-grade ilmenite became available. Contraction in rutile requirements brought about a 30-percent decline in imports from the 1943 record. The 66-percent drop in Brazilian supply accounted for most of the change. At the same time imports from Australia slightly exceeded those of 1943 and made a new high because of the importation of a large volume of the mixed ilmenite-rutile-zircon concentrate that is the major source of zircon for which there was a strong demand.

Titanium concentrates ¹ imported for consumption in the United States, 1940-44, by countries, in short tons

Country of origin	1940	1941	1942	1943	1944
ILMENITE					
Australia ²	2	364	235	390	79
Brazil.....	2	3,709	1,287	.....	5,511
Canada.....	.....	5,725	4,540	65,437	32,580
Ceylon.....	.....	.....	.....	.....	4,648
India and Dependencies.....	221,637	156,079	1,165	8,900	62,066
Portugal.....	.....	969	.....	.....	.....
Total as reported.....	221,641	166,846	7,227	74,787	104,884
Australia: In "zirconium ore" ³	2,250	3,843	3,180	3,306	4,064
Grand total.....	223,891	170,689	10,407	78,093	108,948
Value of "As reported".....	\$750,590	\$629,940	\$60,490	\$386,161	\$596,034
RUTILE					
Australia ²	22	666	1,311	2,802	1,896
Brazil.....	128	2,448	4,966	4,920	1,669
Cameroun (French) ⁴.....	.....	.....	146	1,095	.....
India and Dependencies.....	.....	.....	.....	818	134
Portugal.....	6	.....	.....	.....	.....
Total as reported.....	156	3,114	6,423	9,635	3,699
Australia: In "zirconium ore" ³	2,008	3,177	4,102	4,703	6,320
Grand total.....	2,164	6,291	10,525	14,338	10,019
Value of "As reported".....	\$14,849	\$306,176	\$623,917	\$623,624	\$272,283

¹ Classified as "ore" by the U. S. Department of Commerce.

² All imports of titanium from Australia in 1940-44 were in mixed zircon-rutile-ilmenite concentrates. Totals of mixed concentrates are derived by addition of the U. S. Department of Commerce figures for imports of ilmenite, rutile, and "zirconium ore" from Australia. These totals are divided by the Bureau of Mines (on the basis of surveys of importers) into the three component minerals. The excess quantities of ilmenite and rutile over the quantities reported by the U. S. Department of Commerce in those specific categories are entered as "In 'zirconium ore'."

³ Includes quantities reported by the U. S. Department of Commerce as originating in French Equatorial Africa, from which no rutile production has been recorded.

⁴ Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

in use of titanium dioxide mirrored changes in armament- and ship-construction programs and impending further cut-backs.

Titanium alloys.—The titanium ferro-alloys are important additives in the production of rimming and killed steels. The titanium-treated steels are cleaner, give higher ingot yield, and have generally better physical characteristics than untreated steels and some of those treated with other deoxidizers. In these applications there is little or no titanium residual in the finished steel. Titanium is also used as an alloying element, especially in stainless steels where its main effect is through carbide control to inhibit intergranular corrosion and embrittlement. A titanium alloy steel, now in commercial production, has made possible the direct application of white or light pastel vitreous enamels to steel without the use of a ground-coat enamel. This one-coat enameling steel possesses exceptional cold-drawing characteristics and resistance to sagging or bending at enamel firing temperatures and is reported not to age-strain.^{8,9}

Other uses.—Titanium tetrachloride was used as a screening smoke during the First World War and has been employed in substantial volume during the present conflict. At first it was usually prepared by chlorinating rutile in the presence of carbonaceous material. Subsequently and during the current war, titanium cyanonitride—an electric-furnace product—was reacted with chlorine to make the tetrachloride. These were high-temperature processes requiring careful controls, and the product was likely to be contaminated with impurities contained in the raw materials. Later, better results were obtained by substituting pigment titanium dioxide briquetted with finely ground charcoal and a binder in place of the cyanonitride.

PRICES

No price changes affected any form of titanium in 1944. Ilmenite and rutile prices were fixed by the Office of Price Administration February 22, 1943 (Regulation 327), at levels prevailing in March 1942. Ilmenite, 60 percent TiO_2 , was nominally quoted at \$28-\$30 a long ton, f. o. b. Atlantic seaboard, and rutile, 94 percent TiO_2 , at 8-10 cents a pound. Steel quoted ferrotitanium, ton lots, at \$1.23 per pound of contained Ti for 40- to 45-percent grade and \$1.35 for 20- to 25-percent grade; and ferrocabontitanium, 15-20 percent Ti, at \$142.50 a short ton for 6- to 8-percent carbon and \$157.50 for 3- to 5-percent carbon. Titanium metal, 96-98 percent, was listed at \$5-\$5.50 a pound. The base price of manufactured titanium dioxide remained fixed at $14\frac{1}{2}$ - $16\frac{1}{2}$ cents a pound.

TECHNOLOGY

The Bureau of Mines and Geological Survey made field studies on Wyoming titaniferous magnetite. The Bureau conducted laboratory research on metal and alloy production and on ore dressing of various raw materials.

The Humphreys spiral concentrator has efficiently separated heavy minerals from natural sands, with high recoveries. It is reported to be relatively insensitive to changes in pulp density and quantity and

⁸ Comstock, G. F., and Wainer, E., *New Titanium Steel for Vitreous Enameling*: Iron Age, vol. 155, No. 7, February 1945, pp. 60-63, 152-153.

⁹ Comstock, G. F., *Strain Aging of Killed Low-Carbon Steel, with Particular Reference to the Effect of Titanium*: Proc. Am. Soc. Testing Materials, vol. 43, 1943, pp. 521-541.

grade of feed, and to particle size or shape. In the first commercial application—Oregon chromite-bearing beach sands—a concentration ratio of 2.25 : 1 was obtained, with a recovery of 98 percent.¹⁰ The Florida beach-sand spiral feed has 5½ to 11 percent heavy minerals. The concentrate ranges from 88 to 96 percent heavy minerals, mostly ilmenite and rutile, but was held close to 92 percent. Recovery exceeds 95 percent.¹¹

WORLD PRODUCTION

Data on world production of ilmenite and rutile in recent years are shown in the following table.

World production of titanium concentrates (ilmenite and rutile), 1937-44, by countries, in metric tons

[Compiled by B. B. Waldbauer]

Country	1937	1938	1939	1940	1941	1942	1943	1944
ILMENITE								
Australia:								
New South Wales.....	681	(¹)	742	2,270	4,808	13,700	(¹)	(¹)
Queensland.....					254			
Brazil (exports).....	120	155	10	12	4,471			2,500
Canada.....	3,836	188	3,351	4,114	11,477	9,100	62,992	30,811
Egypt.....	317	90	(¹)	(¹)	2	4,691	(¹)	(¹)
Federated Malay States (exports).....	6,290	6,462	11,098	2,596	(¹)	(¹)	(¹)	(¹)
India, British.....	182,142	256,268	(¹)	2243,850	131,111	49,977	(¹)	(¹)
Norway.....	84,209	62,724	55,027	(¹)	61,086	61,987	66,191	(¹)
Portugal.....	1,133	568	502	899	798		121	(¹)
Senegal.....	3,075	8,436	(¹)	5,798	895	(¹)	(¹)	(¹)
Spain.....					71	85	178	(¹)
United States.....	(¹)	(¹)	13,247	18,750	21,135	70,042	184,657	252,749
RUTILE								
Australia:								
New South Wales.....	1,141	460	790	2,044	4,440	9,100	(¹)	(¹)
Queensland.....					254			
South Australia.....		8	2	2	(¹)			
Brazil (exports).....	768	377	489	499	2,369	4,615	4,557	1,444
Cameroun (French).....	103	118	159	45	(¹)	(¹)	(¹)	(¹)
Norway.....	187	124	166	156	172	(¹)	116	(¹)
South-West Africa.....	16				(¹)	(¹)		(¹)
United States.....	(¹)	(¹)	(¹)	2,620	2,839	2,402	3,617	6,279

¹ Data not available.

² Subject to revision.

³ January to November, inclusive.

⁴ Includes 26 tons of garnet-ilmenite.

⁵ Bureau of Mines not at liberty to publish figures.

⁶ In addition, zircon-rutile-ilmenite concentrates were produced as follows—1937: 73 tons; 1938: 98 tons.

⁷ Less than 1 ton.

⁸ Exports.

Australia.—Beach-sand deposits similar to those of New South Wales, which have been worked for a number of years, are being prospected and developed along 60 miles of potentially productive Queensland coast. Approximate mineral composition of the deposits, usually called "black sands," is as follows: Zircon, 40 to 45 percent; rutile, 30 to 35 percent; and ilmenite, 20 percent. The Minerals Deposits Syndicate in Queensland is now producing a high-grade monazite concentrate. The product from most of the plants is a mixed concentrate, but efforts are being made to produce clean concentrates of individual minerals, mainly rutile and zircon.¹²

¹⁰ Gleeson, George W., Why the Humphreys Spiral Works: Eng. and Min. Jour., vol. 146, No. 3, March 1945, pp. 85-86.

¹¹ Humphreys, I. B., and Hubbard, Judson S., work cited in footnote 4, pp. 83-84.

¹² Engineering and Mining Journal, Queensland: Vol. 145, No. 10, October 1944, pp. 164, 165.

Brazil.—Brazil has the raw materials for the production of titanium oxide, and it is reported that the establishment of such an industry is being considered.¹⁵ There are large quantities of rutile in Ceara, Goiaz, and Minas Gerais. Brazil's deposits of ilmenite and monazite are found on the coast of Espirito Santo and Baía and are among Brazil's long-exploited minerals.

Ceylon.—Ilmenite is found in large quantities on the beaches of Ceylon. The Ceylon Government proposes to establish a plant for manufacturing paints in the island, using ilmenite as the principal pigment base.¹⁴

Egypt.—Ilmenite, zircon, and monazite are obtained in Egypt from black sand at the mouth of the Nile near Rosetta and Damietta. The minerals are extracted in plants at Rosetta and Alexandria.¹⁴

India.—Although the Travancore ilmenite deposits may be approaching exhaustion, other ilmenite-bearing sands are available along the east coast.¹⁶ Fairly large deposits of titaniferous iron ores occur in Mysore.¹⁷ Extensive deposits are also found in Singhbhum and Mayurbhanj which may develop into a future source of titanium.¹⁸

United Kingdom.—Official prices for rutile are unchanged at £54 a long ton for Cameroun concentrates, £42–£50 for Indian concentrates, and £45 for Australian concentrates. Indian ilmenite, 52–54 percent TiO_2 , is quoted at about 30s. per ton, f. a. s.¹⁹ Ferrotitanium price remained at £100 per long ton for the 2- to 3-percent carbon grade (20–25 percent Ti) and 1s. 3½d. per pound for the carbon-free grade.²⁰ Titanium pigment manufacturers in the United Kingdom have formed a Titanium Pigment Manufacturers' Specification Committee whose reported sole object is to assist in the preparation of official specifications involving titanium oxide.²¹

¹⁵ South African Mining and Engineering Journal, Titanium Oxide in Brazil: Vol. 56, part 1, No. 274, Apr. 28, 1945, p. 205.

¹⁶ Mining Journal (London), Ceylon: Vol. 222, No. 5687, Aug. 19, 1944, p. 500.

¹⁷ Foreign Commerce Weekly, Minerals in Egypt: Vol. 17, No. 1, Sept. 30, 1944, p. 38.

¹⁸ Metal Bulletin (London), India's Mineral Industry: No. 2-10, July 14, 1944, p. 5.

¹⁹ Mining Journal (London), India's Metal Industries: Vol. 223, No. 5703, Dec. 9, 1944, p. 758.

²⁰ Metal Bulletin (London), work cited in footnote 16.

²¹ Metal Bulletin (London), No. 2-50, Dec. 5, 1944, p. 21.

²² Metal Bulletin (London), No. 2-56, Dec. 29, 1944, p. 21.

²³ Chemical Age, vol. 50, No. 1256, May 20, 1944, p. 489.

MINOR METALS

By C. E. NIGHMAN

SUMMARY OUTLINE

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BARIUM AND STRONTIUM

The United States is believed to be the largest producer of barium and strontium and their aluminum or aluminum-magnesium alloys; output has been several thousand pounds annually. These metals and others, principally aluminum, calcium, magnesium, thorium, uranium, zirconium, and mischmetal (cerium and lanthanum mostly), are or have been used as "getters"¹ for the removal of residual gases and those evolved during service in all radio tubes and in virtually all other radionic tubes. Barium has been found to be the best all-round material, but it is ordinarily used in alloyed form. Barium-magnesium getter alloys contain 25-30 percent magnesium, barium-aluminum 50 percent barium, barium-aluminum-magnesium 1 part of the first to 3 parts of the second, and that containing strontium about 14 percent barium, 25 percent strontium, and the remainder magnesium. The getter materials are formed in tablets or pellets ranging in weight from about 2 to 40 milligrams, with the most commonly used sizes between 4 and 12 milligrams. The growth of the radio and radionic tube industry affords a measure of barium consumption. The dollar value of tube output in 1941 was 53 million; in 1942, 132 million; in 1943, 304 million; and in 1944, 406 million.

BERYLLIUM

The recession in demand for beryllium that became marked in the second half of 1943 continued in 1944 and resulted in a drop in consumption of one-fourth compared with 1943. Imports declined more than one-third as a result of contract cancellations but were still so much above current consumption that year-end stocks were equivalent to about 2½ years' requirements at the 1944 use rate. Allocation of beryllium under War Production Board Conservation Order M-160, was lifted August 19.

Domestic mine production.—Shipments from mines established a new record 9 percent above the preceding peak in 1943; however,

¹ A comprehensive review of production and application of getters is given in *Light Metals* (London) *Gettering and Getters*: Vol. 7, Nos. 72-73, January-February 1944, pp. 34-52, 77-94.

they covered less than one-fifth of domestic needs. Production expansion was largely a response to Metals Reserve Company increased buying price. The Bureau of Mines and Geological Survey examined beryl deposits in New England, the southern Appalachians, Black Hills, and Rocky Mountains. An unusual beryllium-bearing rock was described by Jahns,² and an occurrence of beryl associated with tantalum and lithium minerals was described by Jahns and Wright.³

Beryllium ore shipped from mines in the United States, 1938-43, by States, in short tons

	1938	1939	1940	1941	1942	1943	1944
Colorado.....		(1)	(1)		3	68	35
Maine.....	25	(1)	(1)	(1)	45	2	2
Massachusetts.....						(1)	4
New Hampshire.....				(1)	16	42	(1)
New Mexico.....						(1)	29
South Dakota.....		84	74	151	205	238	306
Other ¹		11	47	7		6	12
Total:							
Short tons.....	25	95	121	158	269	356	368
Value.....	\$770	\$2,720	\$3,721	\$7,300	\$24,188	\$44,407	\$56,135
Average per ton.....	\$30.80	\$28.63	\$30.75	\$46.20	\$89.92	\$124.74	\$144.67

¹ Included in "Other." Bureau of Mines not at liberty to show separately.

² 1939: Colorado, Maine; 1940: Colorado, Maine; 1941: Maine, New Hampshire, Wyoming; 1943: Massachusetts, New Mexico, North Carolina, Virginia; 1944: Connecticut, New Hampshire, North Carolina, Virginia.

Beryl crystals of great size are occasionally uncovered. The writer is indebted to Arthur F. Johnson, consulting mining engineer of Keystone, S. Dak., for the following information concerning those found on the property of the Black Hills Keystone Corp. In what is called the No. 2 Dike, one crystal mass that contained 24 tons of beryl was mined in 1933. Subsequently three others that provided 16, 11, and 6 tons of beryl, respectively, were excavated. In July 1942 a crystal 19 feet long was uncovered. At the small end it was 18 inches in cross section and at the other was slightly over 5 feet. This crystal weighed 34 tons. Not until November 1943 were any large crystals or masses found in the No. 1 Dike. Then, one mass without definite crystal form produced 26.5 tons. Late in 1944 a gigantic crystal was mined. The cross section was not determined; but the length was 28 feet, and it provided 61¼ tons of beryl. The Highland Lode mine near Custer, S. Dak., is also well-known as a source of large crystals. In 1940 one yielded 7 tons, and in April 1944 one of 5½-ton size was removed.⁴ Crystals weighing up to 1½ tons have been reported from Beryl Mountain near Keene, N. H.⁵

Foreign trade.—Withdrawal of United States Government support in foreign markets, especially in Argentina and Brazil, brought about a 37-percent drop in imports from the 1943 record level. British countries, however, furnished larger tonnages than in 1943. Exports were 19,065 pounds of ore, 84,229 pounds (\$68,090) of metal, alloys, and scrap, and 2,042 pounds (\$7,067) of salts and compounds.

³ Jahns, Richard H., "Ribbon Rock," An Unusual Beryllium-Bearing Tactile: *Econ. Geol.*, vol. 39, No. 3, May 1944, pp. 173-205.

⁴ Jahns, Richard H., and Wright, Lauren P., The Harding Beryllium-Tantalum-Lithium Pegmatites, Taos County, N. Mex.: *Econ. Geol.*, vol. 39, No. 1, January-February 1944, pp. 96-97. Abstract of paper presented at the annual meeting of the American Institute of Mining and Metallurgical Engineers, February 1944.

⁵ Engineering and Mining Journal, Five-Ton Beryl Crystal Mined at South Dakota Property: Vol. 145, No. 10, October 1944, p. 120.

⁶ Pit and Quarry, vol. 37, No. 5, November 1944, p. 96.

Beryllium ore imported for consumption in the United States, 1940-44, by countries, in short tons

Country	1940	1941	1942	1943	1944
Africa:					
British:					
British East Africa.....					15
Southern Rhodesia.....					7
Union of South Africa.....	6		38	86	(1)
Anglo-Egyptian Sudan.....					1
Argentina.....	422	861	703	1,162	229
Australia.....					518
Brazil.....	377	1,805	912	2,551	1,453
India and Dependencies.....			397	509	892
Madagascar.....				74	
Portugal.....				1	
Total:					
Short tons.....	7 805	2,666	2,050	4,840	3,115
Value.....	\$23,865	\$143,992	\$137,597	\$ 377,726	\$286,091

¹ Less than 1 ton.

² 5 tons additional from Mozambique were reported to the Bureau of Mines.

Stocks.—Stocks in the hands of consumers and dealers were reduced to 131 tons from 1,036 at the beginning of the year. Miners disposed of their inventories in anticipation of a price drop after the termination of the Metals Reserve Company purchase program on December 31, 1944. That agency's small-lot purchase depots transferred their beryl stocks early in 1945 to stock piles in consuming areas near Reading, Pa., and Cleveland, Ohio.

Prices.—The Metals Reserve Company raised its buying price for domestic beryl from \$12 a short-ton unit of beryllium oxide to \$14.50, f. o. b. mine in May 1944 and maintained it at that level for the remainder of the year. Beryllium-copper master-alloy was quoted at \$15 a pound contained beryllium.

Uses.—The major use of beryllium is as an alloying element with copper, usually containing about 2 percent Be and generally modified by smaller amounts of cobalt or nickel. Beryllium-copper is widely considered to be indispensable for many end products in which hardness, high tensile strength, and resistance to fatigue with good electrical and heat conductivity are important.⁶ For the most part such products are small in size but find wide application as springs, diaphragms, and Bourdon tubes in measuring instruments, electrical contacts,⁷ and valve springs and guides. Most aviation instruments and many fire-control instruments contain beryllium-copper, and modern transport and bomber planes may have as many as 100 such parts. Other alloys, such as beryllium-nickel and beryllium-aluminum, have not found much application. An alloy containing about 15 to 50 percent beryllium, 5 to 20 percent silver, and the balance substantially aluminum is claimed to have a considerably greater tensile strength at high temperatures (400° to 600° F.) than that of alloys heretofore used in internal-combustion engines such as in newer aircraft engines.⁸ An extraordinary increase in corrosion resistance is claimed for the addition of 0.005 to 0.5 percent beryllium to magnesium.⁹ Beryllium oxide is important as a base for phosphors used

⁶ Metallurgia (Winchester, England), Beryllium-Copper: Vol. 31, No. 185, March 1945, pp. 247-248.

⁷ Metals and Alloys, Beryllium-Copper in Instruments: Vol. 20, No. 3, September 1944, pp. 720, 722. See also Minor Metals chapter, Minerals Yearbook, 1943.

⁸ Kempf, Louis W., and Dean, Walter A. (to Aluminum Co. of America), Aluminum Base Alloy: U. S. Patent 2,309,354, February 13, 1945.

⁹ Metals and Alloys, Alloy Additions: Vol. 21, No. 2, February 1945, p. 434.

in fluorescent lamps.¹⁰ One pound of the oxide is sufficient for about 4,000 tubes. It is also of use for filaments and filament coatings in electric lamps, as electrodes in electron tubes, as a cathode heating element in radio tubes, and in other heating elements. Special crucibles and refractories are also made of the oxide. They are especially useful for high temperature work and are superior in strength to Al_2O_3 , ZrO_2 , ThO_2 , or synthetic MgOAl_2O_3 above $1,400^\circ\text{C}$.¹¹ and have been satisfactorily used for melting pure platinum and beryllium.

Technologic developments.—The Bureau of Mines conducted numerous tests on the concentration of beryl ores and on methods of beryllium analysis during 1944. The history and processing of beryllium were treated by Donald M. Liddell.¹² An improved method of analysis for beryllium in minerals and rocks was described.¹³

World production of beryllium ore, 1937-44, by countries, in metric tons¹

[Compiled by B. B. Waldbauer]

Country	1937	1938	1939	1940	1941	1942	1943	1944
Argentina.....	260	753	299	520	2,186	925	530	(?)
Australia.....			6	2	3	(?)	558	1,300
Brazil (exports).....		203	276	1,472	1,703	1,634	2,027	1,185
India and Dependencies.....	24	15	9	(?)	(?)	1,360	1,462	1,800
Madagascar (estimated exports).....	2	2	(?)	(?)	(?)	(?)	1,67	(?)
Portugal.....	21	27	(?)	(?)	35	(?)	14	140
Spain.....				4	(?)	(?)	(?)	(?)
South-West Africa.....	(?)	(?)	(?)	(?)	20	39	36	11
Union of South Africa (estimate).....	(?)	(?)	(?)	5	(?)	34	78	(?)
United States (mine shipments).....	68	23	86	116	143	244	323	353
Total reported.....	375	1,023	676	2,113	4,090	3,236	4,095	2,998

¹ In addition to countries listed, beryllium ore may also be produced in France, Italy, Kenya, Norway, Portuguese East Africa, Rumania, and U. S. S. R. Canada has produced beryl but has sold none.

² Data not available.

³ Estimate based upon United States imports.

⁴ Estimate.

⁵ January to June, inclusive.

Foreign review.—Australian output in 1943 was valued at £A16,009. Exports were greater in 1944 than in the preceding year. The discontinuance of purchases by United States agencies caused a large drop in Brazilian output. Prices for beryl and tantalite were fixed by the Coordinator of Economic Mobilization in May 1944.¹⁴ They correspond approximately with Metals Reserve Co. specifications dated May 1, 1943, which were superseded by the circular, Information Concerning the Purchase of Domestic Beryl and Tantalite-Columbite Ores, dated July 26, 1943. Beryl was first mined in Kenya, British East Africa, late in 1943. Small shipments were made by air in 1944. Small deposits in Uganda were also worked. Discovery of beryl in the Duncan River section of the Lardeau mining division in British Columbia was reported by the British Columbia Department of Mines. India has extensive pegmatite zones and it is believed to have commercially important beryl reserves; output has grown greatly during the war years. The Metal

¹⁰ Ralston, Oliver C., and Stern, A. George, *Fluorescent Minerals Used in Lighting and Elsewhere*: Bureau of Mines Inf. Circ. 7276, 1944, 18 pp.

¹¹ David, L., *Beryllium Oxide: Metallurgia*, vol. 30, No. 176, June 1944, pp. 91-93.

¹² Iron Age, *Processing of Beryllium (abs.)*: vol. 154, No. 17, October 26, 1944, pp. 60-61.

¹³ Osborn, S. H., and Stross, W., *The Rapid Photometric Determination of Beryllium in Beryllium-Containing Minerals and Rocks: Metallurgia*, Vol. 30, No. 175, May 1944, pp. 3-5.

¹⁴ *Mineração e Metalurgia, Fixados os preços da tantalita e do berilo*: Vol. 8, No. 44, July-September 1944, pp. 146-148.

Bulletin states ¹⁵ that most of the output came from scattered small pegmatite veins in Rajputana, and ore cobbled to over 10 percent BeO may have cost over Rs. 100 a ton at the deposits. Reserves in this area are probably not large. As a part of postwar industrial development plans it has been suggested that reduction of the ore should be carried out in India. Production in Madagascar was probably about 60 metric tons, of which 10 were shipped to the United States in January 1945, and 30 tons were left at Tamatave. Mining was discontinued about midyear. Beryl output of the Jooste Lithium Myne E/S, South-West Africa, was 38 tons in 1942, 36 tons in 1943, and 11 tons in the first half of 1944. In the same period exports from South-West Africa were 153 tons, all to the United Kingdom.

BORON

Production.—Shipments of ferroboron were 112 tons, with a boron content of about 10 tons in 1944 compared with 182 tons containing 26.5 tons of boron in 1943. A substantial part of the drop in shipment to consumers resulted from the 20-percent decline in alloy-steel production from 1943 to 1944. Shippers of ferroboron are the Electro Metallurgical Co., Molybdenum Corp. of America, and Ohio Ferro-Alloys Corp. Complex special boron-alloy addition agents that usually also contain several of the following elements—Al, Si, Ti, Zr, Ca, Mn, and V—are made by the above manufacturers of ferroboron and also by Titanium Alloy Manufacturing Co. and Vanadium Corp. of America. F. W. Berk & Co., Inc., produced for sale elemental amorphous boron of 82-to 86-percent B purity. This is believed to be the first domestic commercial output.

Uses.—The use of a minute quantity of boron added to steel by means of ferro-alloys known as special addition or “needling” agents, or as intensifiers, has been called a major contribution to the war effort. About 0.002 percent B appears to be the optimum amount; above 0.003 percent difficulties arise in hot working, and at 0.007 steel is made almost unworkable.¹⁷ The major effects are an increase in hardenability and improved mechanical properties in the quenched and drawn state; with suitable adjustment of steel chemistry substantial quantities of nickel, chrome, and molybdenum may be replaced. The use of boron with a free-machining steel showed a 31-percent increase in hardenability but a slight loss in machinability.¹⁷ Although improved hardenability resulting from boron additions is well-recognized, it has been stated that boron is “most useful in conjunction with important amounts of other alloying elements, and it plays but a small role in steels which are not thoroughly quenched or otherwise thoroughly hardened.”¹⁸ It has also been suggested that control of hardenability through boron additions in postwar steel will be ineffective because of nickel, chromium, and molybdenum residuals in scrap, except that alloy-free scrap and pig iron be used.¹⁹

¹⁵ Metal Bulletin (London), India's Mineral Industry: No. 2910, July 14, 1944, p. 4.

¹⁶ Mining Journal (London), Boron Alloys: Vol. 222, No. 5668, April 8, 1944, p. 210.

¹⁷ Harvey, T. G., Effect of Boron on Machinability and Hardenability: Iron Age, vol. 155, No. 7, February 15, 1945, pp. 52-54.

¹⁸ Metal Progress, vol. 46, No. 4, October 1944, p. 691.

¹⁹ McQuaid, Harry W., Postwar Steel and Its Treatment: Metal Progress, vol. 46, No. 5, November 1944, p. 1072.

Exports.—Almost the entire quantity of titanium concentrates and alloys exported in 1944 went to Canada. Mexico received 90 percent of the pigment exports; Cuba, 3 percent; Brazil, 2 percent; and other countries, 5 percent. Exports of tetrachloride dropped from 694 short tons in 1943 to 372 tons in 1944; 57 percent went to United Kingdom, 30 percent to Australia, and 13 percent to Canada. The total exports of titanium products (including concentrates) in 1944 were valued at 2¼ million dollars.

Exports of titanium products from the United States, 1940-40, by classes

Year	Concentrates		Metal and alloy (including ferro- alloys)		Dioxide and pig- ments		Tetrachloride and other compounds	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	(¹)	(¹)	(¹)	(¹)	4,962	\$867,535	(¹)	(¹)
1941.....	432	\$70,613	150	\$35,687	7,821	1,609,071	17	\$5,792
1942.....	618	117,886	422	60,938	8,870	1,707,433	24	13,666
1943.....	576	103,947	760	117,402	9,765	1,830,344	728	442,591
1944.....	290	45,797	793	127,145	10,925	1,851,457	375	215,696

¹ Data not available.

² Data cover last 6 months only.

³ Data cover last 4 months only.

STOCKS

Although inventories of ilmenite at the end of 1944 were about one-fourth larger than a year earlier in terms of TiO₂ content, they represented only about 5 months' supply at the 1944 consumption rate. Stocks of rutile increased about 12 percent by the year end and were probably more than 6 months' needs in view of the declining welding-rod output.

Stocks of titanium concentrates in the United States at end of year, 1943-44, in short tons

Stocks	1943				1944			
	Ilmenite		Rutile		Ilmenite		Rutile	
	Gross weight	Estimated TiO ₂ content	Gross weight	Estimated TiO ₂ content	Gross weight	Estimated TiO ₂ content	Gross weight	Estimated TiO ₂ content
Mine.....	3,753	1,771	100	94	1,572	722	252	236
Distributors ¹	5,538	2,492	1,012	941	4,542	2,316	2,532	2,380
Consumers.....	118,263	57,786	1,871	1,745	161,572	72,814	1,720	1,570
Government.....			3,253	3,058			2,500	2,350
Total stocks....	127,554	62,049	6,236	5,838	167,686	75,852	7,004	6,536

¹ Includes ilmenite and rutile content of mixed zirconium-titanium concentrates.

² Revised figures.

CONSUMPTION AND USES

The 19-percent increase in use of ilmenite in 1944 over that of the preceding year may be ascribed to the unsatisfied demand for titanium pigments. Consumption for pigments was 97 percent of the total, most of the remainder going into alloys and cemented carbides. The

diminished consumption of rutile was largely a reflection of the cut-back in welding-rod output; 73 percent of the total was used for welding-rod coatings, and nearly all the remainder for alloys.

Consumption of ilmenite and rutile in the United States, 1943-44, by products, in short tons

Product	Ilmenite		Rutile	
	Gross weight	Estimated TiO ₂ content	Gross weight	Estimated TiO ₂ content
1943				
Pigments (manufactured titanium dioxide) ¹ . . .	290, 573	137, 399	-----	-----
Welding-rod coatings ¹	194	113	12, 358	11, 617
Alloys and carbide	10, 583	4, 546	5, 221	4, 782
Ceramics	-----	-----	21	20
Miscellaneous ²	1, 472	810	34	32
Total consumption	302, 822	142, 868	17, 634	16, 451
1944				
Pigments (manufactured titanium dioxide) ¹ . . .	349, 505	170, 518	-----	-----
Welding-rod coatings ¹	148	82	10, 747	10, 103
Alloys and carbide	10, 174	4, 401	4, 014	3, 683
Ceramics	-----	-----	20	20
Miscellaneous ²	1, 114	474	32	31
Total consumption	360, 941	175, 475	14, 813	13, 837

¹ "Pigments" include all manufactured titanium dioxide, consumption of which in welding-rod coatings was 5,700 tons in 1943 and 3,900 tons in 1944.

² Consists of ilmenite used as a steel flux and rutile used in lamp-electrode coatings and as a steel deoxidizer.

Titanium pigments.—Both production and sales of titanium pigments continued on an upward trend and established new record highs. There was no pronounced change in the sales distribution pattern, which in 1944, according to a large manufacturer, was 75 percent for paint, varnish, and lacquer, 10 percent for paper, 2½ percent for welding-rod coating, 2 percent for floor coverings, 1½ percent for textiles, 1 percent for rubber, and 8 percent for other uses. Demand for pigments continued very strong, and distribution control was maintained under War Production Board Limitation Order M-353 by means of preference ratings. The order was slightly modified by an amendment November 4, 1944; it was revoked March 26, 1945, but was simultaneously replaced by Conservation Order M-340, Miscellaneous Chemicals. The use of titanium pigments has continued to grow at the expense of both lithopone and white lead because of its exceptionally high hiding power. The marketing of the rutile type in 1941 and the chalk-resistant rutile variety in 1942 provided new pigments with 20 to 40 percent higher hiding power than the anatase form that was the only titanium dioxide pigment commercially available before 1941. Hiding power, color, tintability, and chalk resistance have led to the widespread use of these pigments as camouflage or protective coating on ships, planes, and tanks by the United States Government during the war.⁷

Welding-rod coatings.—Production of titanium-coated welding rods in 1944 was 382,000 short tons compared with 481,000 tons produced in 1943 and 321,000 tons in 1942. The indicated 20-percent decline

⁷ Chemical and Metallurgical Engineering, Report on Paints and Varnishes; Vol. 51, No. 11, November 1944, p. 122.

in use of titanium dioxide mirrored changes in armament- and ship-construction programs and impending further cut-backs.

Titanium alloys.—The titanium ferro-alloys are important additives in the production of rimming and killed steels. The titanium-treated steels are cleaner, give higher ingot yield, and have generally better physical characteristics than untreated steels and some of those treated with other deoxidizers. In these applications there is little or no titanium residual in the finished steel. Titanium is also used as an alloying element, especially in stainless steels where its main effect is through carbide control to inhibit intergranular corrosion and embrittlement. A titanium alloy steel, now in commercial production, has made possible the direct application of white or light pastel vitreous enamels to steel without the use of a ground-coat enamel. This one-coat enameling steel possesses exceptional cold-drawing characteristics and resistance to sagging or bending at enamel firing temperatures and is reported not to age-strain.^{8 9}

Other uses.—Titanium tetrachloride was used as a screening smoke during the First World War and has been employed in substantial volume during the present conflict. At first it was usually prepared by chlorinating rutile in the presence of carbonaceous material. Subsequently and during the current war, titanium cyanonitride—an electric-furnace product—was reacted with chlorine to make the tetrachloride. These were high-temperature processes requiring careful controls, and the product was likely to be contaminated with impurities contained in the raw materials. Later, better results were obtained by substituting pigment titanium dioxide briquetted with finely ground charcoal and a binder in place of the cyanonitride.

PRICES

No price changes affected any form of titanium in 1944. Ilmenite and rutile prices were fixed by the Office of Price Administration February 22, 1943 (Regulation 327), at levels prevailing in March 1942. Ilmenite, 60 percent TiO_2 , was nominally quoted at \$28–\$30 a long ton, f. o. b. Atlantic seaboard, and rutile, 94 percent TiO_2 , at 8–10 cents a pound. Steel quoted ferrotitanium, ton lots, at \$1.23 per pound of contained Ti for 40- to 45-percent grade and \$1.35 for 20- to 25-percent grade; and ferrocarbontitanium, 15–20 percent Ti, at \$142.50 a short ton for 6- to 8-percent carbon and \$157.50 for 3- to 5-percent carbon. Titanium metal, 96–98 percent, was listed at \$5–\$5.50 a pound. The base price of manufactured titanium dioxide remained fixed at $14\frac{1}{2}$ – $16\frac{1}{2}$ cents a pound.

TECHNOLOGY

The Bureau of Mines and Geological Survey made field studies on Wyoming titaniferous magnetite. The Bureau conducted laboratory research on metal and alloy production and on ore dressing of various raw materials.

The Humphreys spiral concentrator has efficiently separated heavy minerals from natural sands, with high recoveries. It is reported to be relatively insensitive to changes in pulp density and quantity and

⁸ Comstock, G. F., and Wainer, E., New Titanium Steel for Vitreous Enameling: *Iron Age*, vol. 155, No. 7, February 1945, pp. 60–63, 152–153.

⁹ Comstock, G. F., Strain Aging of Killed Low-Carbon Steel, with Particular Reference to the Effect of Titanium: *Proc. Am. Soc. Testing Materials*, vol. 43, 1943, pp. 521–541.

grade of feed, and to particle size or shape. In the first commercial application—Oregon chromite-bearing beach sands—a concentration ratio of 2.25 : 1 was obtained, with a recovery of 98 percent.¹⁰ The Florida beach-sand spiral feed has 5½ to 11 percent heavy minerals. The concentrate ranges from 88 to 96 percent heavy minerals, mostly ilmenite and rutile, but was held close to 92 percent. Recovery exceeds 95 percent.¹¹

WORLD PRODUCTION

Data on world production of ilmenite and rutile in recent years are shown in the following table.

World production of titanium concentrates (ilmenite and rutile), 1937-44, by countries, in metric tons

[Compiled by B. B. Waldbauer]

Country	1937	1938	1939	1940	1941	1942	1943	1944
ILMENITE								
Australia:								
New South Wales.....	681	(1)	742	2,270	4,808	} 3,700	(1)	(1)
Queensland.....					254			
Brazil (exports).....	120	155	10	12	4,471			\$2,500
Canada.....	3,836	188	3,351	4,114	11,477	9,100	62,992	30,811
Egypt.....	317	90	(1)	(1)	2	4,691	(1)	(1)
Federated Malay States (exports).....	6,290	6,462	11,098	2,596	(1)	(1)	(1)	(1)
India, British.....	182,142	256,208	(1)	\$243,850	131,111	40,977	(1)	(1)
Norway.....	84,209	62,724	55,027	(1)	61,086	61,987	66,191	(1)
Portugal.....	1,133	568	502	899	798		121	(1)
Senegal.....	3,075	8,436	(1)	5,798	895	(1)	(1)	(1)
Spain.....					71	85	178	(1)
United States.....	(1)	(1)	13,247	18,750	21,135	70,042	184,657	252,749
RUTILE								
Australia:								
New South Wales.....	\$1,141	\$460	790	2,044	4,440	} 10,100	(1)	(1)
Queensland.....					254			
South Australia.....		8	2	2	(1)			
Brazil (exports).....	768	377	489	499	2,369	4,615	4,557	\$1,444
Cameroon (French).....	103	118	\$159	45	(1)	(1)	(1)	(1)
Norway.....	187	124	166	156	172	(1)	116	(1)
South-West Africa.....	16				(1)	(1)	(1)	(1)
United States.....	(1)	(1)	(1)	2,620	2,839	2,402	3,617	6,279

¹ Data not available.

² Subject to revision.

³ January to November, inclusive.

⁴ Includes 26 tons of garnet-ilmenite.

⁵ Bureau of Mines not at liberty to publish figures.

⁶ In addition, zircon-rutile-ilmenite concentrates were produced as follows—1937: 73 tons; 1938: 98 tons.

⁷ Less than 1 ton.

⁸ Exports.

Australia.—Beach-sand deposits similar to those of New South Wales, which have been worked for a number of years, are being prospected and developed along 60 miles of potentially productive Queensland coast. Approximate mineral composition of the deposits, usually called "black sands," is as follows: Zircon, 40 to 45 percent; rutile, 30 to 35 percent; and ilmenite, 20 percent. The Minerals Deposits Syndicate in Queensland is now producing a high-grade monazite concentrate. The product from most of the plants is a mixed concentrate, but efforts are being made to produce clean concentrates of individual minerals, mainly rutile and zircon.¹²

¹² Gleeson, George W., Why the Humphreys Spiral Works: Eng. and Min. Jour., vol. 146, No. 3, March 1945, pp. 85-86.

¹³ Humphreys, I. B., and Hubbard, Judson S., work cited in footnote 4, pp. 63-84.

¹⁴ Engineering and Mining Journal, Queensland: Vol. 145, No. 10, October 1944, pp. 164, 165.

Brazil.—Brazil has the raw materials for the production of titanium oxide, and it is reported that the establishment of such an industry is being considered.¹³ There are large quantities of rutile in Ceara, Goiaz, and Minas Gerais. Brazil's deposits of ilmenite and monazite are found on the coast of Espirito Santo and Bafa and are among Brazil's long-exploited minerals.

Ceylon.—Ilmenite is found in large quantities on the beaches of Ceylon. The Ceylon Government proposes to establish a plant for manufacturing paints in the island, using ilmenite as the principal pigment base.¹⁴

Egypt.—Ilmenite, zircon, and monazite are obtained in Egypt from black sand at the mouth of the Nile near Rosetta and Damietta. The minerals are extracted in plants at Rosetta and Alexandria.¹⁵

India.—Although the Travancore ilmenite deposits may be approaching exhaustion, other ilmenite-bearing sands are available along the east coast.¹⁶ Fairly large deposits of titaniferous iron ores occur in Mysore.¹⁷ Extensive deposits are also found in Singhbhum and Mayurbhanj which may develop into a future source of titanium.¹⁸

United Kingdom.—Official prices for rutile are unchanged at £54 a long ton for Cameroun concentrates, £42–£50 for Indian concentrates, and £45 for Australian concentrates. Indian ilmenite, 52–54 percent TiO_2 , is quoted at about 30s. per ton, f. a. s.¹⁹ Ferrotitanium price remained at £100 per long ton for the 2- to 3-percent carbon grade (20–25 percent Ti) and 1s. 3½d. per pound for the carbon-free grade.²⁰ Titanium pigment manufacturers in the United Kingdom have formed a Titanium Pigment Manufacturers' Specification Committee whose reported sole object is to assist in the preparation of official specifications involving titanium oxide.²¹

¹³ South African Mining and Engineering Journal, Titanium Oxide in Brazil: Vol. 56, part 1, No. 2724, Apr. 28, 1945, p. 205.

¹⁴ Mining Journal (London), Ceylon: Vol. 222, No. 5687, Aug. 19, 1944, p. 500.

¹⁵ Foreign Commerce Weekly, Minerals in Egypt: Vol. 17, No. 1, Sept. 30, 1944, p. 38.

¹⁶ Metal Bulletin (London), India's Mineral Industry: No. 2910, July 14, 1944, p. 5.

¹⁷ Mining Journal (London), India's Metal Industries: Vol. 223, No. 5703, Dec. 9, 1944, p. 758.

¹⁸ Metal Bulletin (London), work cited in footnote 16.

¹⁹ Metal Bulletin (London), No. 2950, Dec. 5, 1944, p. 21.

²⁰ Metal Bulletin (London), No. 2956, Dec. 29, 1944, p. 21.

²¹ Chemical Age, vol. 50, No. 1299, May 20, 1944, p. 489.

MINOR METALS

By C. E. NIGHMAN

SUMMARY OUTLINE

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BARIUM AND STRONTIUM

The United States is believed to be the largest producer of barium and strontium and their aluminum or aluminum-magnesium alloys; output has been several thousand pounds annually. These metals and others, principally aluminum, calcium, magnesium, thorium, uranium, zirconium, and mischmetal (cerium and lanthanum mostly), are or have been used as "getters"¹ for the removal of residual gases and those evolved during service in all radio tubes and in virtually all other radionic tubes. Barium has been found to be the best all-round material, but it is ordinarily used in alloyed form. Barium-magnesium getter alloys contain 25-30 percent magnesium, barium-aluminum 50 percent barium, barium-aluminum-magnesium 1 part of the first to 3 parts of the second, and that containing strontium about 14 percent barium, 25 percent strontium, and the remainder magnesium. The getter materials are formed in tablets or pellets ranging in weight from about 2 to 40 milligrams, with the most commonly used sizes between 4 and 12 milligrams. The growth of the radio and radionic tube industry affords a measure of barium consumption. The dollar value of tube output in 1941 was 53 million; in 1942, 132 million; in 1943, 304 million; and in 1944, 406 million.

BERYLLIUM

The recession in demand for beryllium that became marked in the second half of 1943 continued in 1944 and resulted in a drop in consumption of one-fourth compared with 1943. Imports declined more than one-third as a result of contract cancellations but were still so much above current consumption that year-end stocks were equivalent to about 2½ years' requirements at the 1944 use rate. Allocation of beryllium under War Production Board Conservation Order M-160, was lifted August 19.

Domestic mine production.—Shipments from mines established a new record 9 percent above the preceding peak in 1943; however,

¹ A comprehensive review of production and application of getters is given in *Light Metals* (London) *Gettering and Getters*: Vol. 7, Nos. 72-73, January-February 1944, pp. 34-52, 77-94.

they covered less than one-fifth of domestic needs. Production expansion was largely a response to Metals Reserve Company increased buying price. The Bureau of Mines and Geological Survey examined beryl deposits in New England, the southern Appalachians, Black Hills, and Rocky Mountains. An unusual beryllium-bearing rock was described by Jahns,² and an occurrence of beryl associated with tantalum and lithium minerals was described by Jahns and Wright.³

Beryllium ore shipped from mines in the United States, 1938-43, by States, in short tons

	1938	1939	1940	1941	1942	1943	1944
Colorado.....		(1)	(1)		3	68	35
Maine.....	25	(1)	(1)	(1)	45	2	2
Massachusetts.....						(1)	4
New Hampshire.....				(1)	16	42	(1)
New Mexico.....						(1)	29
South Dakota.....		84	74	151	205	238	306
Other ¹		11	47	7		6	12
Total:							
Short tons.....	25	95	121	158	269	356	388
Value.....	\$770	\$2,720	\$3,721	\$7,300	\$24,188	\$44,407	\$56,135
Average per ton.....	\$30.80	\$28.63	\$30.75	\$46.20	\$89.92	\$124.74	\$144.67

¹ Included in "Other." Bureau of Mines not at liberty to show separately.

² 1939: Colorado, Maine; 1940: Colorado, Maine; 1941: Maine, New Hampshire, Wyoming; 1943: Massachusetts, New Mexico, North Carolina, Virginia; 1944: Connecticut, New Hampshire, North Carolina, Virginia.

Beryl crystals of great size are occasionally uncovered. The writer is indebted to Arthur F. Johnson, consulting mining engineer of Keystone, S. Dak., for the following information concerning those found on the property of the Black Hills Keystone Corp. In what is called the No. 2 Dike, one crystal mass that contained 24 tons of beryl was mined in 1933. Subsequently three others that provided 16, 11, and 6 tons of beryl, respectively, were excavated. In July 1942 a crystal 19 feet long was uncovered. At the small end it was 18 inches in cross section and at the other was slightly over 5 feet. This crystal weighed 34 tons. Not until November 1943 were any large crystals or masses found in the No. 1 Dike. Then, one mass without definite crystal form produced 26.5 tons. Late in 1944 a gigantic crystal was mined. The cross section was not determined; but the length was 28 feet, and it provided 61½ tons of beryl. The Highland Lode mine near Custer, S. Dak., is also well-known as a source of large crystals. In 1940 one yielded 7 tons, and in April 1944 one of 5½-ton size was removed.⁴ Crystals weighing up to 1½ tons have been reported from Beryl Mountain near Keene, N. H.⁵

Foreign trade.—Withdrawal of United States Government support in foreign markets, especially in Argentina and Brazil, brought about a 37-percent drop in imports from the 1943 record level. British countries, however, furnished larger tonnages than in 1943. Exports were 19,065 pounds of ore, 84,229 pounds (\$68,090) of metal, alloys, and scrap, and 2,042 pounds (\$7,067) of salts and compounds.

¹ Jahns, Richard H., "Ribbon Rock," An Unusual Beryllium-Bearing Tactite: *Econ. Geol.*, vol. 39, No. 3, May 1944, pp. 173-205.

² Jahns, Richard H., and Wright, Lauren P., The Harding Beryllium-Tantalum-Lithium Pegmatites, Taos County, N. Mex.: *Econ. Geol.*, vol. 39, No. 1, January-February 1944, pp. 96-97. Abstract of paper presented at the annual meeting of the American Institute of Mining and Metallurgical Engineers, February 1944.

⁴ Engineering and Mining Journal, Five-Ton Beryl Crystal Mined at South Dakota Property: Vol. 145, No. 10, October 1944, p. 120.

⁵ Pit and Quarry, vol. 37, No. 5, November 1944, p. 96.

Beryllium ore imported for consumption in the United States, 1940-44, by countries, in short tons

Country	1940	1941	1942	1943	1944
Africa:					
British:					
British East Africa.....					15
Southern Rhodesia.....					7
Union of South Africa.....	6		38	86	(1)
Anglo-Egyptian Sudan.....					1
Argentina.....	422	861	703	1,162	229
Australia.....				457	518
Brazil.....	377	1,805	912	2,551	1,453
India and Dependencies.....			397	509	892
Madagascar.....				74	
Portugal.....				1	
Total:					
Short tons.....	1,805	2,666	2,050	4,840	3,115
Value.....	\$23,865	\$143,992	\$137,597	\$ 377,726	\$286,091

¹ Less than 1 ton.

² 5 tons additional from Mozambique were reported to the Bureau of Mines.

Stocks.—Stocks in the hands of consumers and dealers were reduced to 131 tons from 1,036 at the beginning of the year. Miners disposed of their inventories in anticipation of a price drop after the termination of the Metals Reserve Company purchase program on December 31, 1944. That agency's small-lot purchase depots transferred their beryl stocks early in 1945 to stock piles in consuming areas near Reading, Pa., and Cleveland, Ohio.

Prices.—The Metals Reserve Company raised its buying price for domestic beryl from \$12 a short-ton unit of beryllium oxide to \$14.50, f. o. b. mine in May 1944 and maintained it at that level for the remainder of the year. Beryllium-copper master-alloy was quoted at \$15 a pound contained beryllium.

Uses.—The major use of beryllium is as an alloying element with copper, usually containing about 2 percent Be and generally modified by smaller amounts of cobalt or nickel. Beryllium-copper is widely considered to be indispensable for many end products in which hardness, high tensile strength, and resistance to fatigue with good electrical and heat conductivity are important.⁶ For the most part such products are small in size but find wide application as springs, diaphragms, and Bourdon tubes in measuring instruments, electrical contacts,⁷ and valve springs and guides. Most aviation instruments and many fire-control instruments contain beryllium-copper, and modern transport and bomber planes may have as many as 100 such parts. Other alloys, such as beryllium-nickel and beryllium-aluminum, have not found much application. An alloy containing about 15 to 50 percent beryllium, 5 to 20 percent silver, and the balance substantially aluminum is claimed to have a considerably greater tensile strength at high temperatures (400° to 600° F.) than that of alloys heretofore used in internal-combustion engines such as in newer aircraft engines.⁸ An extraordinary increase in corrosion resistance is claimed for the addition of 0.005 to 0.5 percent beryllium to magnesium.⁹ Beryllium oxide is important as a base for phosphors used

⁶ Metallurgia (Winchester, England), Beryllium-Copper: Vol. 31, No. 185, March 1945, pp. 247-248.

⁷ Metals and Alloys, Beryllium-Copper in Instruments: Vol. 20, No. 3, September 1944, pp. 720, 722. See also Minor Metals chapter, Minerals Yearbook, 1943.

⁸ Kempf, Louis W., and Dean, Walter A. (to Aluminum Co. of America), Aluminum Base Alloy: U. S. Patent 2,369,354, February 13, 1945.

⁹ Metals and Alloys, Alloy Additions: Vol. 21, No. 2, February 1945, p. 434.

in fluorescent lamps.¹⁰ One pound of the oxide is sufficient for about 4,000 tubes. It is also of use for filaments and filament coatings in electric lamps, as electrodes in electron tubes, as a cathode heating element in radio tubes, and in other heating elements. Special crucibles and refractories are also made of the oxide. They are especially useful for high temperature work and are superior in strength to Al_2O_3 , ZrO_2 , ThO_2 , or synthetic MgOAl_2O_3 above $1,400^\circ\text{C}$.¹¹ and have been satisfactorily used for melting pure platinum and beryllium.

Technologic developments.—The Bureau of Mines conducted numerous tests on the concentration of beryl ores and on methods of beryllium analysis during 1944. The history and processing of beryllium were treated by Donald M. Liddell.¹² An improved method of analysis for beryllium in minerals and rocks was described.¹³

*World production of beryllium ore, 1937-44, by countries, in metric tons*¹

[Compiled by B. B. Waldbauer]

Country	1937	1938	1939	1940	1941	1942	1943	1944
Argentina.....	260	753	299	520	2,186	925	530	(²)
Australia.....			6	2	3	(²)	558	³ 500
Brazil (exports).....		203	276	1,472	1,703	1,634	2,027	1,185
India and Dependencies.....	24	15	9	(²)	(²)	³ 360	³ 462	³ 800
Madagascar (estimated exports).....	2	2	(²)	(²)	(²)	(²)	³ 67	(²)
Portugal.....	21	27	(²)	(²)	35	(²)	14	⁴ 60
Spain.....				4	(²)	(²)	(²)	(²)
South-West Africa.....	(²)	(²)	(²)	(²)	20	39	36	⁴ 1
Union of South Africa (estimate) ⁵	(²)	(²)	(²)	5	(²)	34	78	(²)
United States (mine shipments).....	68	23	86	116	143	244	323	352
Total reported.....	375	1,023	676	2,113	4,090	3,236	4,095	2,898

¹ In addition to countries listed, beryllium ore may also be produced in France, Italy, Kenya, Norway, Portuguese East Africa, Rumania, and U. S. S. R. Canada has produced beryl but has sold none.

² Data not available.

³ Estimate based upon United States imports.

⁴ Estimate.

⁵ January to June, inclusive.

Foreign review.—Australian output in 1943 was valued at £A16,009. Exports were greater in 1944 than in the preceding year. The discontinuance of purchases by United States agencies caused a large drop in Brazilian output. Prices for beryl and tantalite were fixed by the Coordinator of Economic Mobilization in May 1944.¹⁴ They correspond approximately with Metals Reserve Co. specifications dated May 1, 1943, which were superseded by the circular, Information Concerning the Purchase of Domestic Beryl and Tantalite-Columbite Ores, dated July 26, 1943. Beryl was first mined in Kenya, British East Africa, late in 1943. Small shipments were made by air in 1944. Small deposits in Uganda were also worked. Discovery of beryl in the Duncan River section of the Lardeau mining division in British Columbia was reported by the British Columbia Department of Mines. India has extensive pegmatite zones and it is believed to have commercially important beryl reserves; output has grown greatly during the war years. The Metal

¹⁰ Ralston, Oliver C., and Stern, A. George, *Fluorescent Minerals Used in Lighting and Elsewhere*: Bureau of Mines Inf. Circ. 7276, 1944, 18 pp.

¹¹ David, L., *Beryllium Oxide*: Metallurgia, vol. 30, No. 176, June 1944, pp. 91-93.

¹² Iron Age, *Processing of Beryllium* (abs.): vol. 154, No. 17, October 26, 1944, pp. 60-61.

¹³ Osborn, S. H., and Stross, W., *The Rapid Photometric Determination of Beryllium in Beryllium-Containing Minerals and Rocks*: Metallurgia, Vol. 30, No. 175, May 1944, pp. 3-5.

¹⁴ *Mineração e Metalurgia, Fixados os preços da tantalita e do berilo*: Vol. 8, No. 44, July-September 1944, pp. 146-148.

Bulletin states¹⁵ that most of the output came from scattered small pegmatite veins in Rajputana, and ore cobbled to over 10 percent BeO may have cost over Rs. 100 a ton at the deposits. Reserves in this area are probably not large. As a part of postwar industrial development plans it has been suggested that reduction of the ore should be carried out in India. Production in Madagascar was probably about 60 metric tons, of which 10 were shipped to the United States in January 1945, and 30 tons were left at Tamatave. Mining was discontinued about midyear. Beryl output of the Jooste Lithium Myne E/S, South-West Africa, was 38 tons in 1942, 36 tons in 1943, and 11 tons in the first half of 1944. In the same period exports from South-West Africa were 153 tons, all to the United Kingdom.

BORON

Production.—Shipments of ferrobaboron were 112 tons, with a boron content of about 10 tons in 1944 compared with 182 tons containing 26.5 tons of boron in 1943. A substantial part of the drop in shipment to consumers resulted from the 20-percent decline in alloy-steel production from 1943 to 1944. Shippers of ferrobaboron are the Electro Metallurgical Co., Molybdenum Corp. of America, and Ohio Ferro-Alloys Corp. Complex special boron-alloy addition agents that usually also contain several of the following elements—Al, Si, Ti, Zr, Ca, Mn, and V—are made by the above manufacturers of ferrobaboron and also by Titanium Alloy Manufacturing Co. and Vanadium Corp. of America. F. W. Berk & Co., Inc., produced for sale elemental amorphous boron of 82-to 86-percent B purity. This is believed to be the first domestic commercial output.

Uses.—The use of a minute quantity of boron added to steel by means of ferro-alloys known as special addition or “needling” agents, or as intensifiers, has been called a major contribution to the war effort. About 0.002 percent B appears to be the optimum amount; above 0.003 percent difficulties arise in hot working, and at 0.007 steel is made almost unworkable.¹⁷ The major effects are an increase in hardenability and improved mechanical properties in the quenched and drawn state; with suitable adjustment of steel chemistry substantial quantities of nickel, chrome, and molybdenum may be replaced. The use of boron with a free-machining steel showed a 31-percent increase in hardenability but a slight loss in machinability.¹⁷ Although improved hardenability resulting from boron additions is well-recognized, it has been stated that boron is “most useful in conjunction with important amounts of other alloying elements, and it plays but a small role in steels which are not thoroughly quenched or otherwise thoroughly through hardened.”¹⁸ It has also been suggested that control of hardenability through boron additions in postwar steel will be ineffective because of nickel, chromium, and molybdenum residuals in scrap, except that alloy-free scrap and pig iron be used.¹⁹

¹⁵ Metal Bulletin (London), India's Mineral Industry: No. 2910, July 14, 1944, p. 4.

¹⁶ Mining Journal (London), Boron Alloys: Vol. 222, No. 5668, April 8, 1944, p. 210.

¹⁷ Harvey, T. G., Effect of Boron on Machinability and Hardenability: Iron Age, vol. 155, No. 7, February 14, 1945, pp. 52-54.

¹⁸ Metal Progress, vol. 46, No. 4, October 1944, p. 691.

¹⁹ McQuaid, Harry W., Postwar Steel and Its Treatment: Metal Progress, vol. 46, No. 5, November 1944, p. 1072.

Prices.—Ferroboron, 17.5 percent B, carlots, was quoted at \$1.20 a pound. Elemental amorphous boron was offered at \$15 a pound, f. o. b. works, in 100-pound lots or over. Higher prices were asked for smaller lots.

CALCIUM

The Electro Metallurgical Co., Metal Hydrides Co., and New England Lime Co. produced calcium metal, hydrides, and alloys in 1944. Production figures are not available, but it has been estimated that output substantially exceeded 100,000 pounds. The alkaline earth metals calcium, barium, and strontium rank fourth, tenth, and fourteenth, respectively, among the 52 metallic components of igneous rocks²⁰ and are therefore relatively abundant. However, the high cost of preparation and circumscribed markets make for a wide disparity between the price of the raw material and metal product. Calcium metal, 97–98 percent, was quoted at \$1.25 a pound in ton lots for the first 10 months of 1944 and then rose to \$1.85, where it remained until the year end.

The metal is used mainly as a deoxidizer for stainless and other steel that must be exceptionally free of harmful impurities. The metal and its hydrides are effective in preparing difficultly reducible metals. Alloys, especially with lead, are growing in use. Methods of analyses have been given,²¹ and the growth of the Electro Metallurgical Co. plant was described.²²

*Calcium metal and calcium-silicon imported for consumption in the United States, 1940–44*¹

Commodity	1940		1941		1942	
	Pounds	Value	Pounds	Value	Pounds	Value
Calcium metal.....	11,900	\$6,518	-----	-----	-----	-----
Calcium-silicon.....	2,131,758	154,424	111,994	\$8,337	60,300	\$10,144

¹ No transactions reported during 1943 and 1944.

CERIUM AND THE RARE-EARTH METALS

Cerium master alloy (misch metal) and commercially pure cerium metal were produced by the Cerium Metals Corp., at Niagara Falls, N. Y., and by the Cooper Metallurgical Laboratory, Cleveland, Ohio. The Cerium Metals Corp. gives the following composition for its cerium standard alloy: Cerium, 45–50 percent; lanthanum, 22–25; neodymium, 15–17; praeosodymium, terbium, yttrium, illinium, and samarium combined, 8–10; iron, 0–5; silicon, 0.1–0.3; and traces of calcium, carbon, and aluminum. Many common and precious metal-cerium master alloys are also available.

An excellent survey of the present position of the chemistry of the rare earths was published.²³ Methods of separation, identification, and

²⁰ Clarke, F. W., and Washington, H. S., The Composition of the Earth's Crust: Geol. Survey Prof. Paper 127, 1924, pp. 24, 31.

²¹ Chemical Age (London), Recent Developments in Analytical Chemistry-12, Calcium: Vol. 51, No. 1316, September 16, 1944, pp. 269–270.

²² Bagley, Glen D., Calcium and Magnesium: Chem. and Eng. News, vol. 22, No. 11, June 10, 1944, pp. 921–924, 958, 960.

²³ Vickery, R. C., The Rare Earths: Metallurgia, vol. 30, No. 177–178, July 1944, pp. 130–134; August 1944, pp. 215–219.

determination were given. Because cerium is the most widespread and the most easily extracted of the rare-earth metals most of available data on applications relate to it.²⁴ The pyrophoric ferro-alloy of cerium is the most widely used material for lighter flints; other important uses are in tracer bullets and other pyrotechnics and as a getter in radionic tubes. Minor quantities are used in aluminum²⁵ and magnesium alloys. The use of 4.5 and 5 percent cerium in aluminum and magnesium alloys in parts of German aviation motors was described.²⁶ In the ceramic field cerium is used as a component of glass and as an abrasive.²⁷ Lanthanum oxide is used for the preparation of color-free optical glasses.²⁸

Canada was the sole source of imports in 1944; these were 20,240 pounds of alloys (\$91,203) and 106 pounds of compounds (\$322), compared with 5,720 pounds of alloys (\$27,589) and 119 pounds of compounds (\$304) in 1943. Exports were 2,651 pounds (\$8,978) of ore and concentrates, none in 1943; and 38,918 pounds (\$116,975) of metal and alloys compared with 54,797 pounds (\$148,891) in the preceding year.

COLUMBIUM AND TANTALUM

Record imports of columbite and tantalite with contraction in demand, especially for tantalite, permitted relaxation of use controls by the War Production Board. In October 1944 the Board classed columbium as in adequate supply to meet war and essential industrial needs. On April 19 an amendment, Preference Order M-156, raised the quantity of tantalum that could be delivered or received monthly from 1 ounce to 3 kilograms. In October it was classed as available for all essential uses and on December 6, 1944, all restrictions on use were lifted by revocation of Order M-156.

Domestic production.—Columbium and tantalum ore shipments declined 44 and 23 percent, respectively, compared with 1943. Distribution of shipments by States for 1944 is not available for publication; however, the major producer was again Arthur Montgomery of Dixon, N. Mex., who shipped 4,720 pounds of microlite of 69 to 70-percent Ta₂O₅ content.

Columbium and tantalum ores shipped from mines in the United States, 1938-44

Year	Columbium ore		Tantalum ore	
	Pounds	Value	Pounds	Value
1938.....	2,000	\$1,000	34,189	\$34,127
1939.....	280	140	60	60
1940.....				
1941.....			250	219
1942.....			200	175
1943.....	5,771	1,465	9,411	27,621
1944.....	3,208	917	7,204	23,317

²⁴ Vickery, R. C., *Industrial Applications of the Rare-Earth Metals: Metallurgia*, vol. 130, No. 180, October 1944, pp. 311-312.

²⁵ Metals and Alloys, Aluminum Alloys Containing Cerium: Vol. 20, No. 4, October 1944, pp. 1072-1078. Condensed from an article in *Novosti Tekniki*, vol. 9, December 1940, pp. 20-21.

²⁶ Metal Progress, *Enemy Matériel from the Metallurgical Point of View*; Report to the War Metallurgy Committee: Vol. 47, No. 2, February 1945, p. 319.

²⁷ Mining Journal (London), *New Use for Monazite Products, Cerium as an Abrasive*: Vol. 222, No. 5677, June 10, 1944, p. 338.

²⁸ Ballard, Albert E., and Martinson, Lawrence E. (to Eastman Kodak Co.), *Purification of Lanthanum Salts*: U. S. Patent 2,364,613, December 12, 1944.

Foreign trade.—The following table shows imports for consumption. Exports in 1944 were 5,052 pounds (\$77,463) of tantalum metal and alloys.

Columbium and tantalum ores imported for consumption in the United States, 1942-44, by countries, in pounds

Country	Columbium ore			Tantalum ore		
	1942	1943	1944	1942	1943	1944
Africa:						
British:						
Gold Coast.....						8,194
Nigeria.....	1,724,800	2,350,329	3,658,084		5,757	10,998
Southern Rhodesia.....				18,971	40,481	10,794
Uganda ¹		3,111	23,603		3,063	6,572
Union of South Africa.....		4,325			1,332	632
Anglo-Egyptian Sudan.....						98
Argentina.....		2,685			2,420	8,233
Australia.....				1,470	10,708	9,315
Belgian Congo.....	36,422		1,373	309,843	157,073	331,941
Brazil.....	1,133			237,210	416,874	440,460
Canada.....						700
India and Dependencies.....		21,600	1,470		1,805	2,442
Mozambique.....					3,567	4,751
Total: Pounds.....	1,762,355	2,382,050	3,684,530	567,494	643,080	835,130
Value.....	\$608,917	\$844,544	\$1,196,899	\$407,418	\$724,066	\$996,721

¹ Classified by U. S. Department of Commerce as British East Africa.

² Classified by U. S. Department of Commerce as from New Zealand, which has no recorded production.

Prices.—The Metals Reserve Company price schedule,²⁹ which included columbite and tantalite, remained effective throughout the year. E&MJ Metal and Mineral Markets quoted tantalum ore at \$2-\$3 a pound of contained Ta₂O₅; tantalum metal (sheet) at \$143 and rod \$160.60 per kilogram; ferrocolumbium, 50-55 percent Cb, at \$2.25-\$2.30 a pound of contained Cb; and columbium metal (sheet) \$500 a kilogram and rod at \$560. All were unchanged throughout the year.

Uses.—The principal use of columbium continued to be as an addition agent to stainless steels, where it acts as a stabilizer by suppressing the formation of harmful chromium carbides and thereby imparts enhanced corrosion resistance. This is of great value in airplane-engine parts and auxiliaries; the rapid expansion in rocket firing presents an extended field for high-temperature corrosion-resistant materials. From 1.75 to 2.75 percent columbium was found in tungsten cores of German projectiles.³⁰ Columbium metal has yet found little application, but markets may be developed. A new process for the production of the metal was announced by the Fansteel Metallurgical Corp.³¹ The major uses for tantalum in relative order of importance remained: As metal in radar and other electronic tubes; as fluoride as a catalyst in synthetic rubber manufacture; and as oxides and carbides in high-speed cutting tools. The first two named account for about 65 percent of consumption.

Foreign review.—The Jantar Nigeria Co., Ltd., produced 327 long tons of columbite in the year ended September 30, 1944, compared

²⁹ See Minor Metals chapter, Minerals Yearbook, 1943.

³⁰ Metal Progress, Enemy Materiel from the Metallurgical Point of View; Report to the War Metallurgy Committee: Vol. 47, No. 2, February 1945, p. 302.

³¹ Iron Age, Reducing Columbium Oxide: Vol. 153, No. 15, April 13, 1944, p. 70.

with about 500 tons in the preceding business year. Contracts with American purchasers were renewed for 1945.³² Tantalo-columbite has been mined in the Belgian Congo since 1934. Most of the output has come from the Geomines properties, where it is a byproduct of cassiterite mining. Reserves were estimated to contain 2,500 metric tons of commercial-grade concentrate at the beginning of 1943. The concentrates contain about 28-30 percent Ta_2O_5 and 30-35 percent Cb_2O_5 . Exports were 242,198 pounds in 1943 and estimated to be 310,000 in 1944. Brazil maintained its position as the world's premier producer. As many as 400 "mines" were in operation. Exports were 253.6 metric tons in 1944, all destined for the United States. Unusually rich deposits of columbium were reported³³ to have been uncovered in the Vishnevi Mountains near Kasli, Chelyabinsk Oblast, U. S. S. R. In January 500 kilograms of concentrates were made. A detailed review of world tantalite resources as of 1944 was published.³⁴

GERMANIUM

The Eagle-Picher Lead Co., Joplin, Mo., in 1944 produced a small quantity of germanium metal and salts. The Metal Bulletin, London, continued to quote germanium metal (99.5 percent) at 19s. 6d. a gram. Among the many rare elements found in coal, germanium and gallium appear to be the only ones that it may be feasible to recover commercially.³⁵ In England flue dusts from chemical works have been found to contain large enough quantities of those elements that they may have commercial possibilities.

INDIUM

Domestic production.—The Bureau of Mines may not publish output figures; however, production appears to have outrun demand substantially, with a resultant sharp rise in inventories.³⁶ In 1944 the producers of indium metal and salts were American Metal Co., Ltd., American Smelting & Refining Co., Anaconda Copper Mining Co., and National Zinc Co. Anaconda continued to dominate the field.

Prices.—Stock accumulations acted as a powerful price depressant, according to the source above named. In March 1944 the metal (99.9 percent indium) price had been reduced from \$10 a troy ounce to \$7.50-\$8.50. By March 1945 sales competition was so great that price became a matter of negotiation. It was said that purchases could be made at \$4, whereas it sold at \$30 in 1936.

Use.—The principal application developed to date has been as an alloy additive in bearing metals to which the indium contributes strong resistance to corrosion by lubricating oil acids, and enhanced fatigue resistance³⁷ with low coefficient of friction.³⁸

³² Metal Bulletin (London), Jantar Output Lower: No. 2956, December 29, 1944, p. 14.

³³ Mining Journal (London) New Niobium Deposits: Vol. 222, No. 5686, August 12, 1944, p. 492.

³⁴ Baker, James S., World Survey of Tantalum Ore: Bureau of Mines Inf. Circ. 7319 (circulation restricted), 1945, 48 pp.

³⁵ Gibson, F. H., and Selvig, W. A., Rare and Uncommon Chemical Elements in Coal: Bureau of Mines Tech. Paper 669, 1944, 23 pp.

³⁶ E&MJ Metal and Mineral Markets, Indium: Vol. 16, No. 10, March 8, 1945, p. 1.

³⁷ Lamb, Vernon A., Electroplating: Metals and Alloys, vol. 21, No. 1, January 1945, p. 132.

³⁸ Cady, Edwin Laird, Noble and Rare Metals: Metals and Alloys, vol. 21, No. 1, January 1945, p. 93.

RADIUM AND URANIUM

Demand for radioactive materials, especially uranium and radium, continued to be strong in 1944. An approximate index is given by the weight of radioactive specimens tested annually by the National Bureau of Standards. In 1944 such specimens contained 79,746 milligrams of radium and 856 milligrams of mesothorium compared with 35,193 and 2,276 milligrams, respectively, in 1943. Amendments to War Production Board Conservation Order M-285, greatly tightened control over uranium ores and products. Imports of radium salts and radioactive materials were the highest on record.

Domestic production.—Virtually the sole domestic source of radium and uranium has been the carnotite ore (also the source of much domestic vanadium) of the Colorado plateau region embracing parts of Arizona, Colorado, and Utah. Small quantities of pitchblende have also been mined. Some was found in sinking on the Wood lode near Central City, Gilpin County, Colo., in 1872, but it was not at once recognized and was thrown away. Later the remainder—amounting to about 3 tons, said to have contained about 70 percent U_3O_8 —was mined and sold in England at \$1.50 a pound. Small quantities were also mined from the nearby Black Hawk and Kirk mines. Up to about 1899 the total production of uraninite (pitchblende) probably had reached 100 tons. Thereafter it dropped greatly because of the discovery of carnotite (essentially a hydrated vanadate of uranium and potassium) in Colorado. Up to about 1906 the output (a few hundred tons annually) was shipped mostly to France and Germany for use as a ceramic colorant and as a uranium alloy-additive to steel. Subsequently it was used as a source of radium, but exports ceased at the beginning of the First World War. Radium was first produced commercially in United States in 1913; soon this country became the major world producer and maintained that position until 1922, when the exceptionally high-grade Belgian Congo ores—up to 60 percent uranium oxide—made Belgium the dominant world factor. In the period 1906–22 mine production of carnotite ore had reached a peak of over 13,000 tons annually; but the average was less than 3,700 tons, and much of this material was used for vanadium recovery with the uranium and radium being lost in tailings. The total United States radium production up to 1925 was estimated ³⁹ by Hess to be about 250 grams. From 1922 to 1936 carnotite production was small, and again nearly all was consumed for its vanadium content and to a small extent for uranium salts; less than 1 gram of radium was produced. After 1936 mine production of carnotite ore increased many fold and continued to rise through 1943 but declined substantially in 1944 with the drop in vanadium requirements. In this period the ores continued to be treated primarily for their vanadium content, but beginning in 1940 recovery of uranium became important. The United States Vanadium Corp. erected at Uravan, Colo., a re-treatment plant of 50 tons daily capacity for uranium recovery, and at least one other tailings re-treatment plant was put into operation in 1943. Data on domestic recovery of uranium and radium have not been available for 3 years. It is evident, however, that substantial output has been obtained from tailings re-treatment, but the potential output is materially greater.

³⁹ Hess, Frank H., *Rare Metals, Radium, and Uranium*: Bureau of Mines Mineral Resources of the United States 1926, part I, p. 268.

Foreign trade.—A new high record was set for radium imports in 1944. All the radium, mesothorium, and 4,675 pounds of uranium oxide and salts imported came from Canada. The remainder—5,750 pounds of uranium oxide and salts—was received from the United Kingdom.

In Canada the Eldorado Mining & Refining, Ltd., mine on Great Bear Lake, N. W. T., and the refinery at Port Hope, Ontario, worked full time as a Crown operation on essential and war needs.⁴⁰ Radium and uranium salts are the major products. The plant capacity has been estimated at 80 to 100 grams of radium annually. The International Uranium Mining Co., Ltd., whose property is about 10 miles from the Eldorado mine, was reported to have undertaken an exploratory drilling campaign in 1943.

According to Chemical Age,⁴¹ China received 50 milligrams of radium for therapeutic use.

In keeping with its continental despoliation plans, Germany was said to have removed 8 grams of radium from the Curie Foundation, leaving only 6 grams in Paris. Italy was also forced to turn over its stocks of radium.⁴² It has been planned to recover uranium and ferro-alloy elements from residues of the Swedish State-owned shale-oil plant at Kvarntorp.⁴³

In Peru the State reserved to itself the rights to all radioactive mineral deposits in seven of the mining districts of the Department of Arequipa. A uranium deposit was reported to have been discovered in the Alaisk Ridge in Kirghizia, U. S. S. R. Mining is planned on an industrial scale after completion of exploration.⁴⁴ Pitchblende and other radioactive minerals have been reported⁴⁵ found in the State of Merida, Venezuela.

Radium salts, radioactive substitutes, and uranium ore and compounds imported for consumption in the United States, 1940-44

Year	Radium salts			Radioactive substitutes ¹ (value)	Uranium ore		Uranium oxide and salts	
	Grams	Value			Pounds	Value	Pounds	Value
		Total	Average per gram					
1940.....	30.311	\$748,097	\$24,700	\$5,650	2,400,198	\$2,110,927	240,199	\$388,355
1941.....	4.412	110,202	25,000	13	.....	.....	387,505	501,370
1942.....	23.043	377,326	16,400	50	541,307	806,919	377,398	851,098
1943.....	90.755	1,366,538	15,100	35,589	.....	.....	211,348	413,410
1944.....	101.290	1,374,933	13,600	128,010	.....	.....	10,425	11,074

¹ Principally mesothorium.

Prices.—Quoted price for radium in salts remained at \$25-\$30 a milligram throughout the year. The Oil, Paint and Drug Reporter quoted black uranium oxide at \$2.55 a pound and the orange salt (sodium uranate) unchanged at \$1.65.

⁴⁰ Mining Journal (London), Canada's Great Metal Industries, Radium: Vol. 224, No. 5709, January 20, 1945, p. 39.

⁴¹ Chemical Age (London), vol. 51, No. 1316, September 16, 1944, p. 284.

⁴² Chemical Age (London), vol. 51, No. 1321, October 21, 1944, p. 406. Metal Bulletin (London), No. 251, Dec. 8, 1944, p. 4.

⁴³ Foreign Commerce Weekly, Swedish Industries, Trends in Wartime: Vol. 17, No. 6, November 4, 1944 pp. 44-45.

⁴⁴ Chemical Age (London), vol. 51, No. 1320, October 14, 1944, p. 377.

⁴⁵ Engineering and Mining Journal, vol. 145, No. 10, October 1944, p. 155.

Uses.—Until recent years the major use for radium has been in the treatment of cancer and skin diseases. In 1939 about 157 grams of radium were in medical use in the United States. It had been estimated that such requirements were increasing at the rate of about 10 grams yearly, but the use of high-voltage X-rays and radioactivated materials has been competitive in this field.

Radium has been successfully used in treating an inflammation of the middle ear that has been noticeable among aviators who fly at high altitudes or engage in dive bombing.⁴⁶ Radium and radioactive substances are also reported to have speeded the production of penicillin.⁴⁷ About 1933 radium was first used industrially for the non-destructive testing of relatively heavy metals for hidden defects. This nondissipative use has grown greatly, especially under the war-time stimulus for speedy production of high-grade matériel that contains heavy castings or forgings and a tremendous quantity of welded joints. Much industrial radiography is also carried out with X-ray apparatus, but the greater penetrating power of the gamma rays of radium compared with X-rays and simplicity of equipment and relative ease of transport give some advantage to radium, especially for examination of heavier sectioned material as in the case of steel, over 3 to 4 inches in thickness. In 1944 it was estimated by the War Production Board that about 36 grams were put into industrial and medical radiographic use, largely the former, compared with 25 grams in 1943.

During and after the First World War much use was made of radium-bearing self-luminous paints for watch, clock, and instrument dials. This application fell into disrepute because of the numerous deaths directly attributable to radium poisoning or exposure to the constantly discharged rays. However, effective protective procedures have been developed, and their application has made possible without hazard the use of radioactive luminous compounds. The compound most used, known as 14112, was developed by the Air Corps. Although it contains about $2\frac{1}{2}$ times as much radium as the 38 M used in the First World War, it loses 90 percent of the emitted light intensity in one-half second after removal of the ultraviolet excitation, thus removing the danger of showing a plane's position to an adversary.⁴⁸ Wartime applications for aircraft and ship instrument dials, ground direction markers, gun sights, compasses, and other instruments consumed about 50 grams in 1944 compared with 75 grams in 1943 and 40 grams in 1942.

Uses of uranium for the most part have been (as salts) in ceramics and as catalysts in the chemical industry. About the beginning of the century there was interest in its use for armor plate and again in the early 1920's for the manufacture of high-speed steels, but they did not attain general acceptance because other tool steels of essentially the same characteristics could be more readily and cheaply produced. However, some alloys have been prepared, and ferrouanium, containing about 39 percent U, has been offered for sale in recent years.

Uranium has found virtually no employment as metal. Scientific and public interest, however, was highly aroused by the potential

⁴⁶ Science News Letter, Radium Successful for Treating Aviator's Ear: Vol. 46, No. 19, November 4, 1944, p. 297.

⁴⁷ Science News Letter, Penicillin Production Speeded by Use of Radium: Vol. 46, No. 15, October 7, 1944, p. 232.

⁴⁸ Steel, Luminous Paint: Vol. 116, No. 8, February 19, 1945, pp. 120, 122, 125.

development of atomic energy from nuclear fission in which the uranium isotope of atomic mass number 235 offers the greatest possibilities. The proportion of U^{235} to the "normal" uranium atom U^{238} in all uranium minerals and salts is 1 to 139. Separation and isolation of uranium 235 was accomplished in the United States at least as early as 1939 by means of the atom-smashing cyclotron as a source of bombarding neutrons. The energy expenditure, however, was about 15 times that released. Other more effective methods have been employed since. Thermal diffusion apparatus offers some promise of relatively speedy concentration of the U^{235} atom. A mixture of radium and beryllium embedded in paraffin will serve as a source of neutrons for the bombardment of the uranium atom 238 which will then split as a result of chain reaction.

If a method of production with concomitant controls of the enormous energy release can be effected, fantastic possibilities arise. As an explosive the total energy content, weight for weight, is said to be some 18 billion times greater than the energy yielded by any known chemical combustion process. In other words, an atomic explosion would be many million times more powerful than that of any known explosive.

Foreign production.—The radium plant of the Cie. Générale Metallurgique de Hoboken at Oolen, Belgium, was found to be intact after the reoccupation of Belgium by Allied armies and was said to be in operation in the spring of 1945. It had been in German hands from May 1940. This was believed to be the world's largest radium refinery and treated ores from the Belgian Congo. During the German occupation period those ores had been sent to Canada and the United States for treatment. The Belgian Congo Government presented 3 grams of radium in 1944 to the Soviet Union for use in military hospitals.⁴⁹

SELENIUM AND TELLURIUM

Domestic production.—Selenium output dropped 24 percent in 1944 from the 1943 record high, and producers' shipments fell 19 percent. Tellurium production rose 23 percent, but sales continued to decline and were the lowest since 1938. Year end producers' stocks of selenium were greater than a year's needs at the 1940-44 average, and those of tellurium were the equivalent of about $1\frac{1}{2}$ years' requirements at the period's average.

Salient statistics of elemental selenium and tellurium in the United States, 1940-44

Year	Selenium					Tellurium ¹		
	Production (pounds)	Producers' sales ² (pounds)	Producers' stocks at end of year (pounds)	Imports ³		Production (pounds)	Producers' sales ² (pounds)	Producers stocks at end of year (pounds)
				Pounds	Value			
1940.....	328, 731	368, 709	206, 800	134, 429	\$198, 163	85, 622	88, 996	85, 700
1941.....	620, 493	681, 650	146, 000	197, 873	268, 161	224, 639	239, 983	20, 400
1942.....	506, 426	316, 613	341, 900	83, 666	127, 004	224, 132	98, 796	145, 700
1943.....	636, 581	521, 779	455, 677	81, 720	142, 032	56, 174	62, 260	139, 403
1944.....	486, 446	423, 906	517, 217	97, 800	170, 582	69, 025	45, 323	163, 105

¹ Includes tellurium content of small quantity of oxide.

² Bureau of Mines not at liberty to publish value. Quantities for 1942-44 represent producers' shipments.

³ Includes selenium salts.

⁴⁹ Foreign Commerce Weekly, Belgian Congo Donates Radium to U. S. S. R.: Vol. 17, No. 11, December 9, 1944, p. 36.

Foreign trade.—Selenium imports came entirely from Canada in 1944. Tellurium is not shown separately in import records. Producers reported exports of 13,191 pounds of selenium including that in compounds and 288 pounds of tellurium in 1944. In 1943 the respective figures were 7,218 and 233 pounds.

Prices.—According to E&MJ Metal and Mineral Markets, prices of selenium (black, powdered 99.5 percent) and of tellurium were nominal and unchanged at \$1.75 a pound throughout the year.

Uses.—The glass industry absorbs a large part of the selenium production; some is used in rubber manufacture and lesser quantities are used in photoelectric cells, stainless steels, and copper. As an antioxidant selenium improves lubricating oils.⁵⁰ The recovery of selenium was described.⁵¹ The principal use for tellurium has been in rubber compounding. It is also used in lead to provide work hardenability and to improve resistance to acids. Minute quantities added to cast iron increase chill depth, hardness, and resistance to some acids.⁵² It has been suggested that it may be a suitable alloying element for high-temperature-resistant material needed for jet-propulsion planes or rockets.⁵³

Foreign production.—Preliminary figures for Canada's production of selenium and tellurium in 1944 were, respectively, 345,000 pounds and 56,900 pounds compared with 374,013 pounds and 8,600 pounds in 1943.

THALLIUM

The 1944 production of thallium in the United States increased slightly over that of 1943. The American Smelting & Refining Co., the sole producer, recovers the metal as a byproduct from cadmium production. Most of the metal is converted to the poisonous thallium sulfate that is used as a rodenticide and for the extermination of ants and some other insects. Based on estimates furnished by the Fish and Wildlife Service, domestic requirements for thallium sulfate would be about 6,000 pounds for the fiscal year beginning July 1, 1945, and about 7,500 pounds for the following year. In addition thereto there have been heavy demands by the military for rat control in the war theatres. The probable supply-demand deficit was so large that a voluntary distribution control was set up early in 1945, and on May 29, 1945, the War Production Board placed thallium chemicals under allocation. Schedule 107 of General Allocation Order M-300 covers thallium acetate, thallium chloride, thallium formate, and thallium sulfate. The sulfate is usually prepared from the metal but may be derived from the other compounds named. Foreign supplies were unavailable during the European war period, but in the late spring of 1945 about 3,000 pounds were acquired from Belgium and France. The Fish and Wildlife Service has been making field tests of substitute poisons, but their efficiency had not been demonstrated by May 1945. Thallium production was reported⁵⁴ from Canada for the first time. The Hudson Bay Mining & Smelting Co., Ltd., at Flin Flon, Manitoba, had an output in 1944 of 128 pounds valued at \$1,690.

⁵⁰ Science News Letter, Addition of Selenium Improves Lubricating Oil: Vol. 47, No. 6, February 10, 1945, p. 89.

⁵¹ Chemical Age, Selenium Recovery: Vol. 102, No. 1332, January 6, 1945, Metallurgical Section, pp. 11-14.

⁵² Crout, J. S., Chilled Iron with Tellurium: Foundry, vol. 72, No. 11, November 1944, pp. 89, 218, 220.

⁵³ Daily Metal Reporter, Sees New Alloys Necessary for Jet Propelled Planes: Vol. 44, No. 224, p. 5.

⁵⁴ Dominion Bureau of Statistics, Preliminary Report of Canada's Mineral Production for the Calendar Year 1944: January 2, 1945, pp. 2, 5.

Methods of recovery from the dusts arising from the treatment of zinc ores or scrap were described.⁵⁵

Thallium metal was quoted by E&MJ Metal and Mineral Markets at \$10 a pound for the first 6 months of 1944, in the third quarter at \$12.50, and in the last quarter at \$12 a pound. Thallium sulfate (99 percent) has been quoted by the Oil, Paint, and Drug Reporter at \$12.50 a pound, f. o. b. works, since September 1942.

ZIRCONIUM

Domestic production.—The output of zircon in the United States in 1944 was again negligible in terms of requirements. The sole producer remained the Riz Mineral Co., which concentrated sand mined near Vero Beach, Indian River County, Fla. The Humphreys Gold Corp. early in 1944 leased the plant and property of the Rutile Mining Co. of Florida, a former producer of crude zircon concentrates from beach sands near South Jacksonville, Fla. The Humphreys Corp. expects to begin production of zircon in mid-1945 from tailings resulting from its ilmenite and rutile recovery operation.

Foreign trade.—Imports of zirconium concentrates in 1944 were 34 percent less than in 1943 and approximately one-half those in 1942. Distribution of foreign receipts by sources and classes of ore are given in the following table. Australian beach sand deposits were described.⁵⁶ During 1944 exports were: Ore and concentrates, 80 short tons (\$9,098); metal and alloys, 117 tons (\$100,040); and compounds, 233 tons (\$70,652).

Zirconium concentrates imported for consumption in the United States, 1940-44, by countries, in short tons¹

Year	Zircon from—				Baddeleyite from Brazil	Accessory titanium minerals ²	Total zirconium concentrates ³	
	Australia	Brazil	India	Total			Short tons	Value
1940.....	7,387	(⁴)	3,609	10,996	41,591	4,258	16,845	252,749
1941.....	14,669	(⁴)	963	15,632	45,002	7,020	27,674	604,744
1942.....	11,145	-----	196	11,341	15,283	7,282	33,906	816,364
1943.....	11,472	110	-----	11,582	8,821	8,009	28,412	667,704
1944.....	11,317	101	-----	11,418	2,231	10,384	24,033	576,299

¹ Totals and country break-down by the U. S. Department of Commerce. Mineral break-down by Bureau of Mines.

² Rutile and ilmenite content of mixed zirconium-titanium concentrates imported from Australia.

³ Classified as "ore" by U. S. Department of Commerce.

⁴ Zircon imports from Brazil, 1940-41, included with baddeleyite.

Consumption and uses.—Zircon shipments in 1944 to consumers rose to a new high of 14,484 short tons compared with 8,954 tons in 1943. Based on information furnished by the principal shippers, uses in 1944 were, in percentages, as follows: Electrical and chemical porcelains, 44; metal and alloys, 23; pottery glazes, 9; refractories, 9; porcelain enamels, 8; glass, 4; other 3. Iron Age stated⁵⁷ that about 1,000 pounds of pure, ductile zirconium were being made annually by deposition on a hot filament from the volatilized tetraiodide. This method of production was described by the Foote Mineral Co.⁵⁸

⁵⁵ Sanderson, L., Thallium: Canadian Min. Jour., vol. 65, No. 9, September 1944, pp. 624-625.

⁵⁶ Engineering and Mining Journal, Value of 1943 Mineral Output Drops—Queensland Beach Sands Mined for Zircon and Rutile: Vol. 145, No. 10, October 1944, pp. 164-165.

⁵⁷ Iron Age, Nonferrous Metallurgy: Vol. 155, No. 1, January 4, 1945, pp. 73-74.

⁵⁸ Raynor, W. M., Zirconium—an Abundant "Rare" Metal: Foote Prints, vol. 15, No. 2, summer, 1943, pp. 3, 6-8.

Zirconium hydride (ZrH_2) was advertised as a safe material for use in powder metallurgy for production of sintered alloys. The extreme explosibility of zirconium metal powder was described by the Bureau of Mines in 1943.

Stocks.—At the close of 1944 distributors' stocks of zircon (including zircon content of zirconium-titanium concentrates) were 4,550 short tons, a decrease of 3,647 tons during the year. Zirconium-ore imports had been Government-controlled (General Imports Order M-63) because the Australian material carries about 50 percent rutile and ilmenite; supplies of both were deficient. Since adequate supplies of rutile for essential uses became available during 1944, imports of rutile and zirconium were freed from that control October 1, 1944.

Prices.—Zirconium ore, 55 percent ZrO_2 , f. o. b. Atlantic seaboard, was quoted nominally at \$65-\$75 throughout the year by E&MJ Metal and Mineral Markets. The quoted prices for zirconium ferro-silicon, 12-15 percent zirconium, at \$102.50-\$107.50 per gross ton, and 35-40 percent zirconium at 14-16 cents a pound; and \$7 a pound for powdered zirconium metal, remained unchanged in 1944.

BITUMINOUS COAL AND LIGNITE ¹

By W. H. YOUNG, R. L. ANDERSON, AND L. H. ISAAC

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SURVEY OF THE BITUMINOUS-COAL AND LIGNITE INDUSTRY IN 1944

The production of soft coal attained a new all-time high in 1944—an estimated output of 620,000,000 net tons³ compared with the previous peak of 590,177,069 tons in 1943. Although production was the greatest on record it still was not sufficient to meet the demand created by the expanding war economy. Labor difficulties caused several interruptions to production. According to the Bureau of Labor Statistics, there were 792 strikes in soft-coal mines in 1944, with 229,907 workers involved, 1,056,341 man-days lost (an average of 4.6 days per man), and an estimated loss in production of 6,000,000 tons. Difficulty in obtaining supplies and machinery and a shortage of men also caused a loss in output.

Production.—The outstanding feature related to the production of 620,000,000 tons in 1944 was the elimination of seasonal declines, due largely to the Government program urging consumers to accumulate stocks during the summer. Throughout most of the year production remained near 12,000,000 tons per week, except when output was reduced because of holidays.

Consumption.—Five of the major classes of consumers used more coal in 1944 than in 1943, and the other five used less. The total consumption in 1944 was approximately 4,000,000 tons less than in 1943. Table 5 shows the trends in consumption for the major classes of consumers.

¹ Data for 1944 are preliminary; detailed statistics with final revisions will be released later. Data for 1943 are final.

² Following United States usage, the term "trillion" in this report is equivalent to 1,000,000,000,000.

³ Throughout this chapter, "tons" refers to net tons of 2,000 pounds, unless otherwise indicated.

Changes in stocks.—The reserve supply of bituminous coal and lignite in the hands of industrial consumers and in retail coal yards increased from a total of 56,686,000 tons at the beginning of 1944 to 57,204,000 tons at the close. The average days' supply of stocks increased from 30 to 32. Stocks on the upper Lake docks increased 533,308 tons from January 1 to December 31, 1944.

Distribution.—Shipments of bituminous coal and lignite during 1944 showed increases in most of the channels of distribution compared with 1943. Table 10 shows trends in distribution of bituminous coal and lignite for 1938-44. Changes in the 1943-44 monthly volume of the more important movements are shown in figure 9.

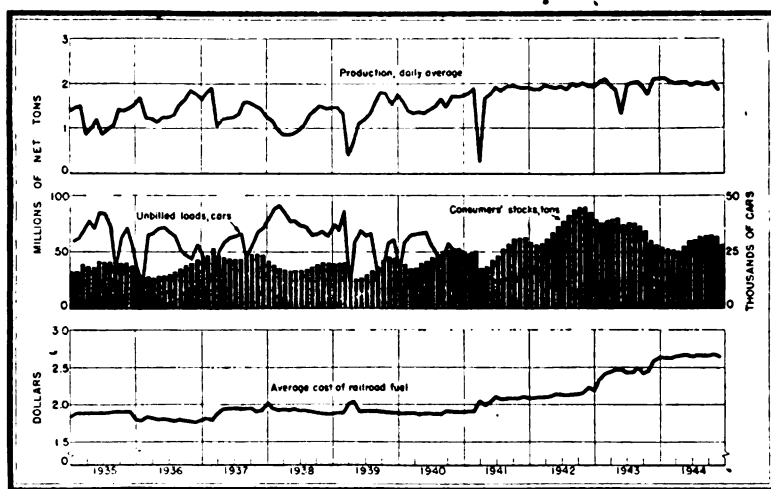


FIGURE 1.—Trends of production, stocks, and prices of bituminous coal and lignite in the United States, 1935-44.

Mechanization.—The quantity of coal loaded mechanically at underground mines in the United States continued to advance during 1944. Mechanical loading increased from 48.9 percent of the total underground output in 1943 to an estimated 50.5 percent in 1944. Sales of underground loading equipment, in terms of capacity, were 6 percent greater than in 1943.

Mechanical cleaning.—The total capacity of mechanical-cleaning equipment sold for use at bituminous-coal mines in 1944 was estimated at 5,400 tons of cleaned coal per hour, an increase of 55 percent from the previous year.

Trend of employment.—An estimate of the average number of men employed at bituminous-coal and lignite mines in 1944 indicates a drop to 383,000 men from 416,007 in 1943.

Index to capacity.—The potential output upon a 308-day basis (6-day week, full-time capacity) was 689,000,000 tons in 1943. As it is not possible for all mines to operate 308 days per year, a more conservative figure of 280 days was suggested some years ago by the coal committee of the American Institute of Mining and Metallurgical Engineers (see Minerals Yearbook, 1935, pp. 631-632). The average output per day worked in 1943 was 2,235,519 tons, which (if applied

to 280 days) gives an annual potential output of 626,000,000 tons compared with the actual total production of 590,177,069 tons. For purposes of historical comparison a capacity at 261 days, based on the 5-day week, is also shown in figure 4 and in tables 12 and 13.

Trend of fuel efficiency.—For many years before 1942 there was a steady trend toward increased fuel efficiency. During the period 1942–44 this trend was arrested or reversed, and some industries exhibited decreased fuel efficiency (see table 6).

Competition of oil and gas.—In 1944, as in 1943, competition between the various fuels was far outweighed by the urgent need for adequate production of all fuels to satisfy the continued increase in demand.

Electric power utilities consumed 3 percent more bituminous coal, 16 percent more fuel oil, and 18 percent more gas than in 1943.

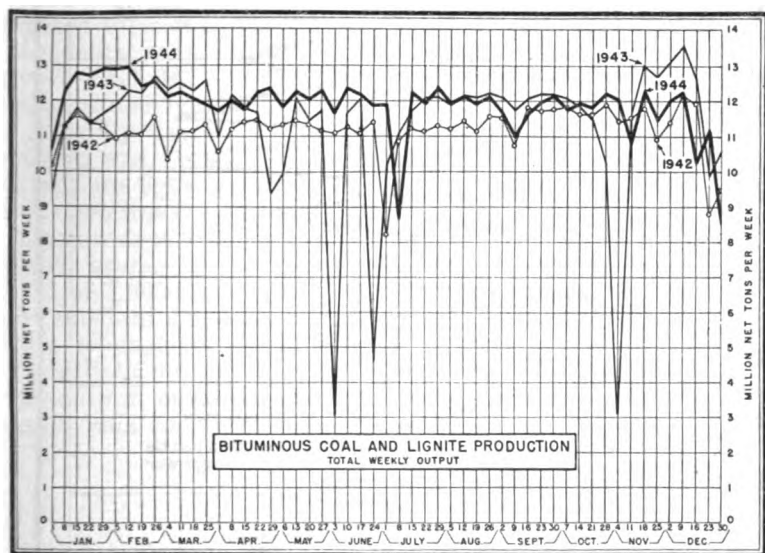


FIGURE 2.—Production of bituminous coal and lignite in the United States, by weeks, 1942–44.

Class I railroads increased their consumption of coal 1 percent in 1944, while their purchases of fuel oil decreased from 1943 purchases by 2 percent.

Further curtailment of the manufacture of domestic coal-burning equipment is reflected by statistics published by the Bureau of the Census. Factory sales of domestic stokers were reduced from 4,460 in 1943 to 1,714 in 1944. However, shipments of domestic oil burners, boiler-burner units, and furnace-burner units increased from 27,956 in 1943 to 45,752 in 1944.

SOURCES OF DATA

Bituminous-coal and lignite production statistics for 1944 are preliminary estimates based upon (1) weekly or monthly reports of railroad carloadings of coal and beehive coke by all the important carriers, (2) shipments by river as reported by the United States Army Engineers, (3) direct reports from a number of mining companies, and

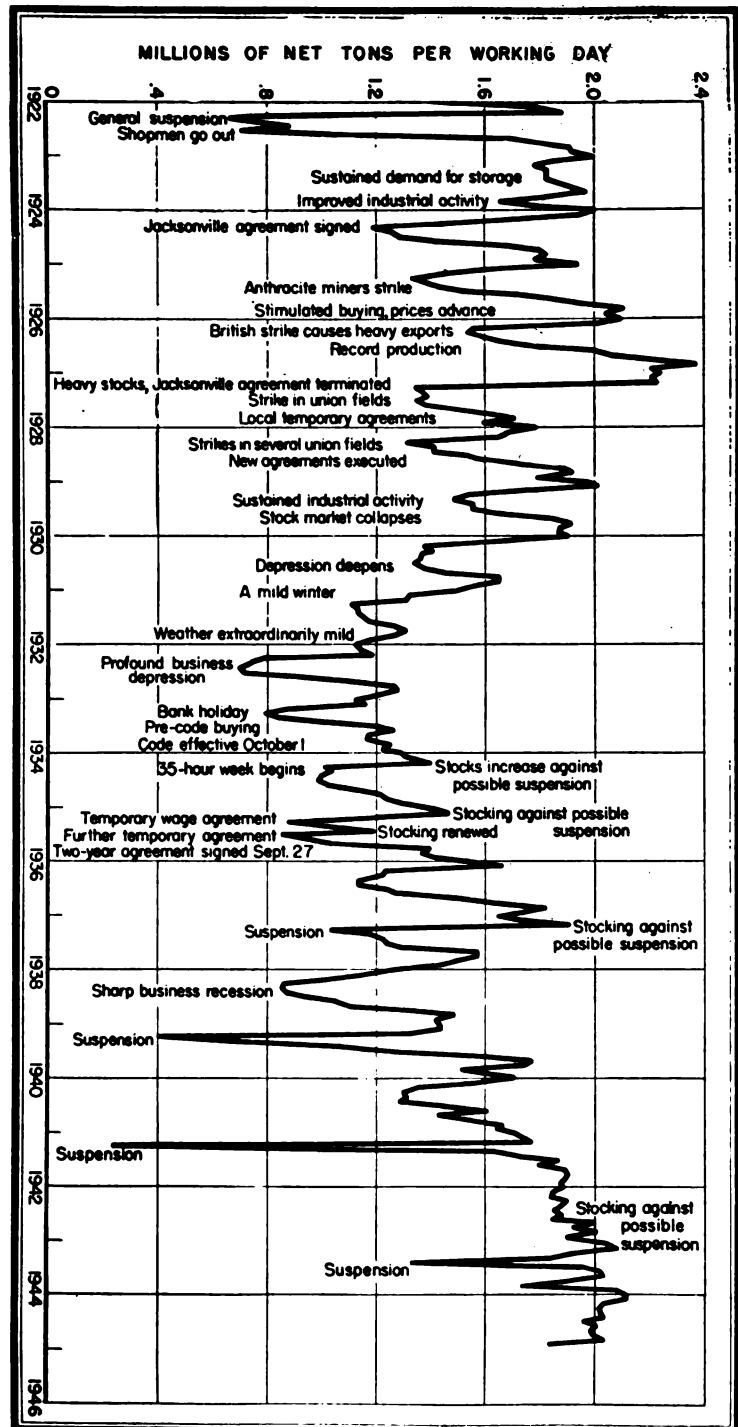


FIGURE 8.—Average production of bituminous coal and lignite in the United States per working day in each month, 1922-44.

(4) monthly production statements compiled by a number of local operators' associations and State mine departments. In the estimates for 1944, allowance has been made for commercial truck shipments, local sales and colliery fuel, and small trucking or wagon mines producing over 1,000 tons a year.

Data for 1943 are final and are based upon detailed annual reports of production and mine operation furnished by the producers. As in previous years, all but a small percentage of the output was covered by the reports submitted. For the remaining output not directly reported—consisting chiefly of small mines—it has been possible to obtain reasonably accurate data from the records of the State mine departments, which have statutory authority to require such reports, or, in a few instances, from railroad carloadings.

Final figures of employment obtained from the annual canvass of production as shown in this report for 1943 differ slightly from the estimated total of employment based on the sample monthly canvass of accidents as published October 27, 1944, in Mineral Industry Surveys HSS 341. According to the annual canvass, the average number of men employed amounted to 416,007, whereas, according to the monthly sample raised to 100 percent, the average number employed was 414,700. The major cause for this slight discrepancy was that one figure represented a complete canvass and the other was based upon less complete returns.

In accordance with the practice followed by the Bureau of Mines in previous years, the statistics in this report relate to mines having an output of 1,000 tons a year or more and do not attempt to include many small mines producing less than 1,000 tons a year that sell their output by wagon or truck.

These data include, for convenience and historical comparison, the small output of anthracite and semianthracite produced outside Pennsylvania and the production of lignite.

SALIENT STATISTICS

TABLE 1.—*Salient statistics of the bituminous-coal and lignite industry in the United States, 1943-44*

[All tonnage figures represent net tons]

	1943	1944 (preliminary)	Change in 1944
Production	590,177,069	620,000,000	Percent +5.1
Consumption in the United States ¹	594,517,000	590,694,000	— .6
Stocks at end of year:			
Industrial consumers and retail yards	56,686,000	57,204,000	+ .9
Stocks on upper Lake docks	5,629,410	6,162,718	+9.5
Unbilled loads, at mines or in classification yards ²	44,000	38,000	—13.6
Price indicators (average per net ton):			Cents
Average cost of railroad fuel purchased, f.o.b. mines ³	\$2.42	\$2.65	+23
Average cost of coking coal at merchant byproduct ovens ⁴	\$5.21	\$5.43	+22
Average retail price—35 cities ⁵	\$9.94	\$10.27	+33
Average railroad freight charge per net ton ⁶	\$2.30	\$2.21	—9
Underground loading machinery sold: ⁷			Percent
Mobile loading machines (number)	234	282	+20.5
Scrapers (number)	13	20	+53.8
Conveyors, including those with duckbills (units)	798	580	—27.3
Surface stripping	79,685,175	95,000,000	+19.2
Mechanically loaded underground	249,805,214	265,000,000	+6.1
Mechanically cleaned	145,575,849	150,000,000	+3.0
Average number of men employed ⁸	416,007	383,000	—7.9
Fuel-efficiency indicators:			
Pounds of coal per kw.-hr. at electric power plants ⁹	1.31	1.30	— .8
Pounds per 1,000 gross ton-miles—railroads ¹⁰	114	115	+ .9

¹ Represents certain classes of consumers only. See table 5 for consumers included.² Association of American Railroads.³ Interstate Commerce Commission (class I steam railways, including class I switching and terminal companies). Excludes freight charges.⁴ As reported by coke operators.⁵ Bureau of Labor Statistics.⁶ Average receipts per net ton of revenue bituminous coal and lignite originated, as reported by the Interstate Commerce Commission.⁷ Young, W. H., and Anderson, R. L., *Mechanization Sales: Coal Age*, February 1945, pp. 104-106, and *Min. Cong. Jour.*, February 1945, pp. 40-42.⁸ The figure for 1943 is based upon reports of mine operators producing over 1,000 tons. The figure for 1944 is estimated from various sources.⁹ Federal Power Commission.¹⁰ Interstate Commerce Commission; includes coal equivalent of fuel oil consumed.

PRODUCTION BY WEEKS AND MONTHS

The following tables summarize the preliminary statistics of weekly and monthly production of bituminous coal and lignite in 1944. The figures are estimates based upon daily and weekly statements of cars of coal and beehive coke loaded by the principal railroads and of shipments over the more important originating rivers. Allowance has been made for commercial truck shipments, local sales, and colliery fuel. The estimates given are based upon the latest information available and differ in some instances from the current figures previously published in the Weekly Coal Reports.

For method used in counting holidays, see chapter on Coal in Mineral Resources of the United States, 1930, page 631.

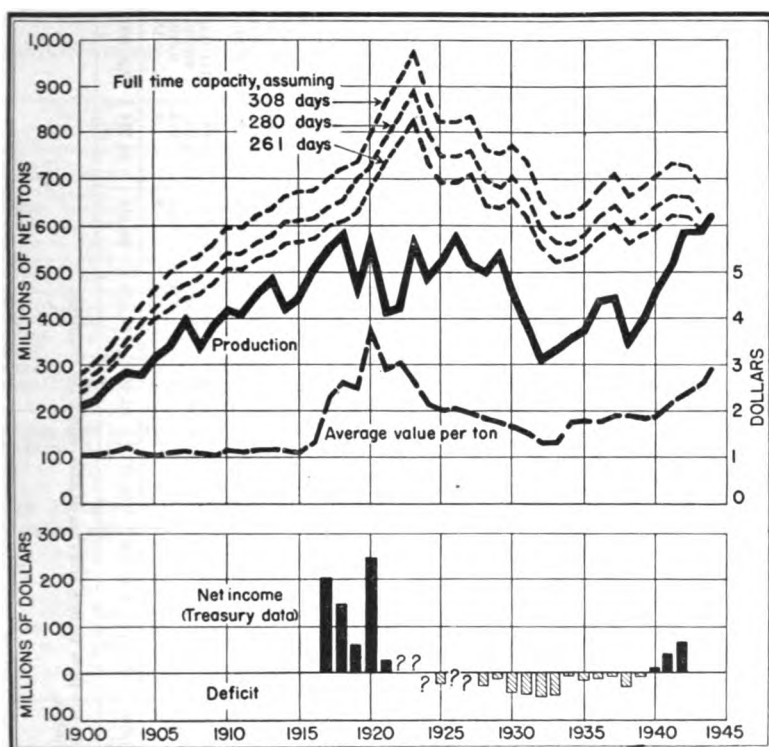


FIGURE 4.—Trends of bituminous coal and lignite production, realization, mine capacity, and net income or deficit in the United States, 1900-1944

TABLE 2.—Estimated weekly production of bituminous coal and lignite in the United States in 1944

Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)	Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)
Jan. 1.....	1,230,000	10.7	1,845,000	July 1.....	11,886,000	6	1,981,000
Jan. 8.....	12,296,000	6	2,049,000	July 8.....	8,674,000	5	1,735,000
Jan. 15.....	12,832,000	6	2,139,000	July 15.....	12,290,000	6	2,048,000
Jan. 22.....	12,710,000	6	2,118,000	July 22.....	11,973,000	6	1,996,000
Jan. 29.....	12,906,000	6	2,151,000	July 29.....	12,385,000	6	2,064,000
Feb. 5.....	12,808,000	6	2,150,000	Aug. 5.....	11,957,000	6	1,993,000
Feb. 12.....	12,975,000	6	2,163,000	Aug. 12.....	12,142,000	6	2,024,000
Feb. 19.....	12,410,000	6	2,068,000	Aug. 19.....	11,934,000	6	1,989,000
Feb. 26.....	12,593,000	6	2,099,000	Aug. 26.....	12,076,000	6	2,013,000
Mar. 4.....	12,115,000	6	2,019,000	Sept. 2.....	11,684,000	6	1,947,000
Mar. 11.....	12,300,000	6	2,050,000	Sept. 9.....	10,994,000	5.4	2,036,000
Mar. 18.....	12,072,000	6	2,012,000	Sept. 16.....	11,692,000	6	1,949,000
Mar. 25.....	11,954,000	6	1,992,000	Sept. 23.....	11,966,000	6	1,994,000
Apr. 1.....	11,725,000	5.6	2,094,000	Sept. 30.....	12,180,000	6	2,030,000
Apr. 8.....	12,036,000	6	2,006,000	Oct. 7.....	11,726,000	6	1,954,000
Apr. 15.....	11,710,000	6	1,952,000	Oct. 14.....	11,940,000	6	1,990,000
Apr. 22.....	12,210,000	6	2,035,000	Oct. 21.....	11,847,000	6	1,975,000
Apr. 29.....	12,337,000	6	2,056,000	Oct. 28.....	12,208,000	6	2,035,000
May 6.....	11,854,000	6	1,976,000	Nov. 4.....	12,019,000	6	2,003,000
May 13.....	12,253,000	6	2,042,000	Nov. 11.....	10,820,000	5.5	1,967,000
May 20.....	12,012,000	6	2,002,000	Nov. 18.....	12,310,000	6	2,052,000
May 27.....	12,286,000	6	2,048,000	Nov. 25.....	11,436,000	5.6	2,042,000
June 3.....	11,652,000	5.7	2,044,000	Dec. 2.....	12,025,000	5.9	2,038,000
June 10.....	12,352,000	6	2,059,000	Dec. 9.....	12,217,000	6	2,036,000
June 17.....	12,173,000	6	2,029,000	Dec. 16.....	10,244,000	6	1,707,000
June 24.....	11,870,000	6	1,978,000	Dec. 23.....	11,158,000	6	1,860,000
				Dec. 30.....	8,456,000	5	1,691,000
					620,000,000	308.4	2,010,000

¹ Figures represent output and number of working days in that part of week included in calendar year shown. Total production for week of Jan. 1, 1944, was 10,515,000 tons.

² Average daily production for entire week and not for working days in calendar year shown.

TABLE 3.—Estimated monthly production of bituminous coal and lignite in the United States, by States, in thousands of net tons, in 1944

[Bituminous coal and lignite figures are preliminary estimates based on railroad carloadings and river shipments of coal and beehive coke, supplemented by direct reports from a number of mining companies, local coal operators' associations, and detailed monthly production statistics compiled by the State Mine Departments of Colorado, Illinois, Pennsylvania, Washington, and West Virginia. In making the estimates, allowance is made for commercial truck shipments, local sales, and colliery fuel, and for small trucking mines producing over 1,000 tons a year. The estimates here given differ in a few cases from the monthly figures previously published in the Weekly Coal Reports.]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama.....	1,684	1,600	1,696	1,493	1,633	1,553	1,495	1,657	1,572	1,575	1,619	1,418	18,905
Alaska.....	32	34	39	25	27	29	28	23	25	31	32	27	4,710
Arkansas and Oklahoma.....	430	418	396	350	393	372	360	401	432	432	392	356	8,110
Colorado.....	866	810	806	650	595	552	596	632	635	677	663	718	21
Georgia and North Carolina.....	1	1	1	1	2	2	2	2	2	2	3	2	76,960
Illinois.....	7,078	6,821	6,994	6,163	6,475	6,440	5,966	6,499	5,811	6,319	6,158	6,340	28,140
Indiana.....	2,568	2,393	2,802	2,134	2,306	2,334	2,358	2,413	2,253	2,197	2,343	2,439	2,690
Iowa.....	282	266	253	188	165	197	191	204	224	237	238	245	5,140
Kansas and Missouri.....	740	733	748	623	720	651	620	690	672	647	658	638	49,887
Kentucky.....	4,212	4,090	4,287	3,802	4,393	4,246	3,926	4,475	4,157	4,307	4,177	3,725	18,350
Eastern.....	1,488	1,480	1,487	1,463	1,660	1,665	1,605	1,546	1,497	1,582	1,492	1,355	18,350
Western.....	179	180	179	160	170	175	163	180	163	168	142	121	1,600
Maryland.....	15	15	16	13	13	12	10	13	13	13	12	14	4,880
Michigan (bituminous and lignite).....	426	410	415	386	351	364	321	420	419	464	426	478	1,705
Montana.....	155	153	177	152	165	143	130	152	137	141	145	135	1,520
New Mexico.....	328	292	224	128	128	141	150	177	190	270	264	288	32,940
North and South Dakota (lignite).....	2,800	2,780	2,857	2,728	3,089	3,070	2,757	3,036	2,823	2,859	2,845	2,296	148,800
Ohio.....	12,640	12,791	13,220	12,015	13,400	12,910	11,990	12,820	12,318	12,380	11,943	10,373	7,120
Pennsylvania (bituminous).....	673	646	700	602	638	622	587	613	598	600	600	580	19,900
Tennessee.....	17	14	14	11	10	7	9	9	8	10	9	14	1,515
Texas (bituminous and lignite).....	663	654	650	600	615	580	517	582	544	548	590	580	7,120
Virginia.....	1,814	1,700	1,788	1,585	1,756	1,692	1,527	1,738	1,582	1,695	1,676	1,368	19,900
Washington.....	1,140	1,133	1,288	1,116	1,130	1,133	1,110	1,136	1,118	1,225	1,118	1,128	11,080
West Virginia.....	9,723	9,252	10,043	9,298	9,802	9,621	8,845	9,984	9,080	9,139	8,958	7,555	52,755
Northern.....	4,240	4,342	4,375	4,062	4,511	4,522	4,388	5,096	4,491	4,572	4,522	3,794	52,755
Southern.....	866	860	882	701	782	708	632	768	777	831	892	874	8,665
Wyoming.....	2	1	1	1	1	1	1	1	1	1	2	2	15
Other Western States.....	54,102	52,817	54,880	49,510	53,930	52,712	48,986	54,177	50,480	51,813	50,819	45,774	620,000
Total.....	54,102	52,817	54,880	49,510	53,930	52,712	48,986	54,177	50,480	51,813	50,819	45,774	620,000

1 Includes operations on the N. & W. O. & O. Virginian, K. & M. B. O. & G., and on the B. & O. in Kanawha, Mason, and Clay Counties.
 2 Rest of State, including the Panhandle district and Grant, Mineral, and Tucker Counties.

AVERAGE VALUE BY STATES

TABLE 4.—Average value per ton, f. o. b. mines, of bituminous coal and lignite in the United States, by States, 1943-44¹

State	1943	1944 ²	State	1943	1944 ²
Alabama.....	\$3.45	\$3.88	New Mexico.....	3.53	3.89
Alaska.....	6.87	6.73	North and South Dakota (lignite)...	1.51	1.53
Arkansas.....	4.18	4.64	Ohio.....	2.42	2.65
Colorado.....	3.31	3.55	Oklahoma.....	3.16	3.25
Georgia.....	3.78	4.05	Pennsylvania.....	2.82	3.12
Illinois.....	2.13	2.23	Tennessee.....	2.83	3.12
Indiana.....	2.09	2.25	Texas (bituminous and lignite).....	1.09	1.09
Iowa.....	3.10	3.53	Utah.....	3.00	3.20
Kansas.....	2.50	2.59	Virginia.....	2.95	3.24
Kentucky.....	2.70	2.98	Washington.....	4.41	4.75
Maryland.....	3.01	3.34	West Virginia.....	2.80	3.07
Michigan.....	4.87	5.42	Wyoming.....	2.38	2.63
Missouri.....	2.50	2.59			
Montana (bituminous and lignite)...	1.75	1.98	Total.....	2.60	2.93

¹ Average gross realization, selling cost not deducted.² Preliminary.

CONSUMPTION

TABLE 5.—Consumption of bituminous coal and lignite, by consumer class, with retail deliveries in the United States, 1935-44, in thousands of net tons¹

Year	Colliery fuel	Electric power utilities ²	Railroads (class I) ³	Coke		Steel and rolling mills	Coal-gas retorts	Cement mills	Other industries ⁴	Retail-dealer deliveries	Total of classes shown
				Bee-hive ovens	By-product ovens						
1935.....	3,103	33,013	77,109	1,499	49,046	11,747	2,245	3,516	91,589	83,990	354,827
1936.....	3,227	40,029	86,391	2,698	63,244	13,471	1,945	4,771	108,620	84,200	408,596
1937.....	3,052	42,871	98,080	4,977	69,575	12,853	1,650	5,247	123,410	90,076	430,771
1938.....	2,493	38,245	78,921	1,360	45,266	8,412	1,644	4,483	92,360	68,530	336,734
1939.....	2,545	43,979	79,072	2,298	61,216	9,808	1,614	5,274	98,900	71,570	378,236
1940.....	2,443	50,973	85,180	4,803	76,553	10,040	1,746	5,533	106,280	87,700	431,331
1941.....	2,489	61,861	97,394	10,529	82,609	10,902	1,659	6,832	120,720	97,460	492,445
1942.....	2,708	65,686	115,410	12,578	87,974	10,434	1,721	7,570	131,550	104,780	540,629
1943.....	2,702	76,403	130,253	12,441	90,019	11,238	1,805	8,861	141,211	122,764	594,617
1944 ¹	2,850	78,883	132,049	10,931	94,654	10,734	1,545	8,789	130,353	124,906	590,694

¹ These data have been assembled to show changes in consumption of bituminous coal and lignite by such classes of consumers as report currently. The total, including retail deliveries, does not represent grand total consumption in the United States. Bunker-fuel statistics are not available for publication at present. Owing to the omission of bunker fuel, to revisions in data covering production, exports, and imports, and to unavoidable irregularities that occur in reports from respondents who are unable to require that definitions applied and closing dates observed by their accountants be identical with those generally used in the surveys of bituminous coal and lignite consumption, the "total of classes shown" for each year in the above table cannot be reconciled with the calculated consumption obtained by the formula: "Production plus imports minus exports plus or minus net changes in consumers' stocks."

² Geological Survey and Federal Power Commission. Represents bituminous coal and lignite consumed by public utility power plants in power generation, including a small quantity of coke amounting to approximately 100,000 tons annually.

³ Association of American Railroads. Represents consumption of bituminous coal and lignite by class I railways for all uses, including locomotive, powerhouse, shop, and station fuel. The Interstate Commerce Commission reports that in 1943 consumption for all uses by class I line-haul railways plus purchases for class II and class III railways, plus purchases by all switching and terminal companies combined, was 125,788,769 tons of bituminous coal and lignite. Similar data from the Interstate Commerce Commission are not yet available for 1944.

⁴ Estimates based upon reports collected by the Solid Fuels Administration for War from a selected list of representative manufacturing plants.

⁵ Subject to revision.

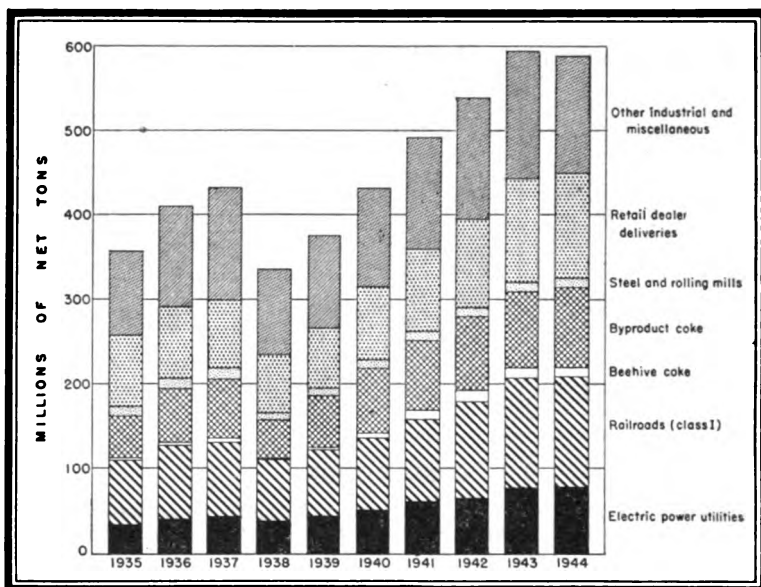


FIGURE 5.—Consumption of bituminous coal and lignite, by consumer class, with retail deliveries in the United States, 1935-44.

FUEL EFFICIENCY

TABLE 6.—Indicators of effect of fuel economy on consumption of coal in the United States per unit of performance since the World War of 1914-18

	Pounds	Reduction from base period (percent)
Steam railroads:		
Pounds per 1,000 gross ton-miles freight service:		
Average:		
1919-20	170	
1943	114	32.9
1944	115	32.4
Pounds per passenger-train car-mile:		
Average:		
1919-20	18.5	
1943	15.0	18.9
1944	14.8	20.0
Electric public-utility power plants:		
Pounds per kilowatt-hour:		
1919	3.2	
1943	1.5	59.4
1944	1.3	59.4
Iron and steel—pounds coking coal per net ton of pig: ¹		
1918	3,194	
1943	2,620	18.0
1944	2,629	17.7
Coke manufacture: Savings of heat values through recovery of gas, tar, light oils, and breeze by extension of byproduct in place of beehive coking, 1913-14, expressed as percent of coal used for all coke in 1944: ²		18.5

¹ Includes only savings through higher yields of merchantable coke per ton of coal charge and lower consumption of coke per ton of iron. Excludes economies through recovery of byproducts, which are covered in next item.

² These byproducts are used in part for boiler fuel, in part for metallurgical purposes, in part for domestic heating and coking, and to a small extent for automotive fuel.

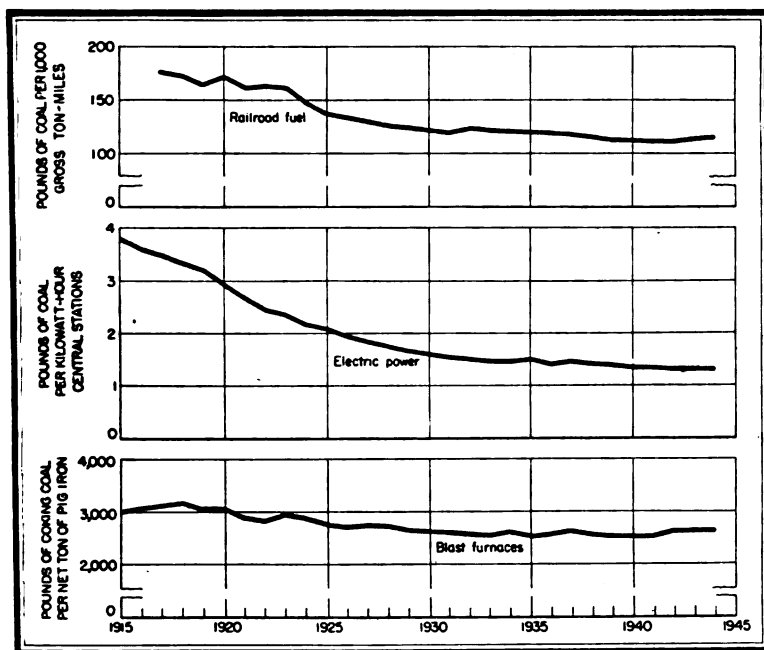


FIGURE 6.—Trends in fuel efficiency in the United States, 1915-44.

RELATIVE RATE OF GROWTH OF COAL, OIL, AND WATER POWER, 1889-1944

The total supply of available energy in the form of coal, oil, natural gas, and water power in 1944 was 35,707 trillion B. t. u.—a 5.6-percent increase over 1943 (see fig. 7).

The figures are expressed in British thermal units because some common denominator is necessary for such unlike quantities as tons of coal, barrels of oil, and cubic feet of gas. Table 7 summarizes the equivalent of each of the fuels in trillions of British thermal units. Water power is represented by the equivalent fuel required to perform the same work. The table covers the years since 1935. Details for 1889 to 1934 are given in Minerals Yearbook, 1937, page 807.

In converting water power to its fuel equivalent, two alternative assumptions have been made. The first, as in previous issues of these tables, assumes a *constant* fuel equivalent of 4.02 pounds of coal for each kilowatt-hour of water power produced throughout the entire period from 1889 to 1944. This factor was selected because it represents, in round numbers, the average efficiency of all central stations generating steam-electric power in 1913, the base period used. The usefulness of the *constant* factor lies in showing the rate at which water power is being developed. It permits direct comparison between the relative increase (in kilowatt-hours of water power) and the corresponding increase or decrease (in tons of coal, barrels of oil, or cubic feet of gas produced). On the other hand the *constant* factor makes no allowance for the fact that coal and other fuels produced today are used more efficiently than formerly.

To show the influence of improving fuel efficiency, a second computation of the energy equivalent of water power has therefore been made. This assumes a *prevailing* fuel equivalent, diminishing year by year, which represents the average performance of all fuel-burning central electric stations for the year in question. This average has declined from about 7.05 pounds of coal per kilowatt-hour in 1899 to 1.30 pounds in 1944. (The *prevailing* factor is thus much above the *constant* factor in 1899 and much below it in 1944.) The *prevailing* fuel equivalent indicates more nearly the quantity of fuel that would have been needed in any one year to generate the same power in a steam-electric station. It should be noted, however, that the ultimate uses to which the water power generated is put often displace fuel burned much less efficiently than in central stations and that in any instance no other important branch of fuel consumption has made advances in fuel efficiency approaching that of the central stations.

As these tables attempt to determine the total energy from all fuels and from water power, the ideal factor for converting water power into fuel equivalent would be the average efficiency of all forms of fuel consumption in each year. No basis for determining such an all-embracing average exists at present, but enough is known to make certain that it would show much less reduction from 1899 to 1944 than do the central stations. For the present, a just comparison of the changing contributions of water power and of fuel to the national energy supply would lie somewhere between the results shown by the *constant* equivalent and the *prevailing* central-station equivalent in these tables.

As in earlier issues of these tables, the figures for oil and natural gas represent the entire production of crude petroleum and of gas. Most of this production does not come into direct competition with coal. Much of the supply of both oil and gas is used in regions of the country, such as California and portions of the Southwest, where coal is available only at unusually high cost because of heavy transport charges. Nearly half of the natural gas is used in the field for drilling or operating oil and gas wells and pipe lines or for the manufacture of carbon black. More than half the oil is used in the form of gasoline, kerosine, and lubricants, for which purposes coal cannot well compete, except at very much higher levels of oil prices. Even these refined products, however, involve a certain measure of indirect competition with coal, for the energy market of the country is becoming more fluid and competitive, and a demand that cannot be met by one source of supply tends to fall back on the others.

The subject of interfuel competition is exceedingly complex, and an elaborate analysis and the accumulation of data not now available would be required to determine even approximately how much of any one fuel actually has been displaced either by other fuels or by water power. The present tables do not permit determination of such displacement; their purpose is rather to measure the long-time trends in the total demand for energy.

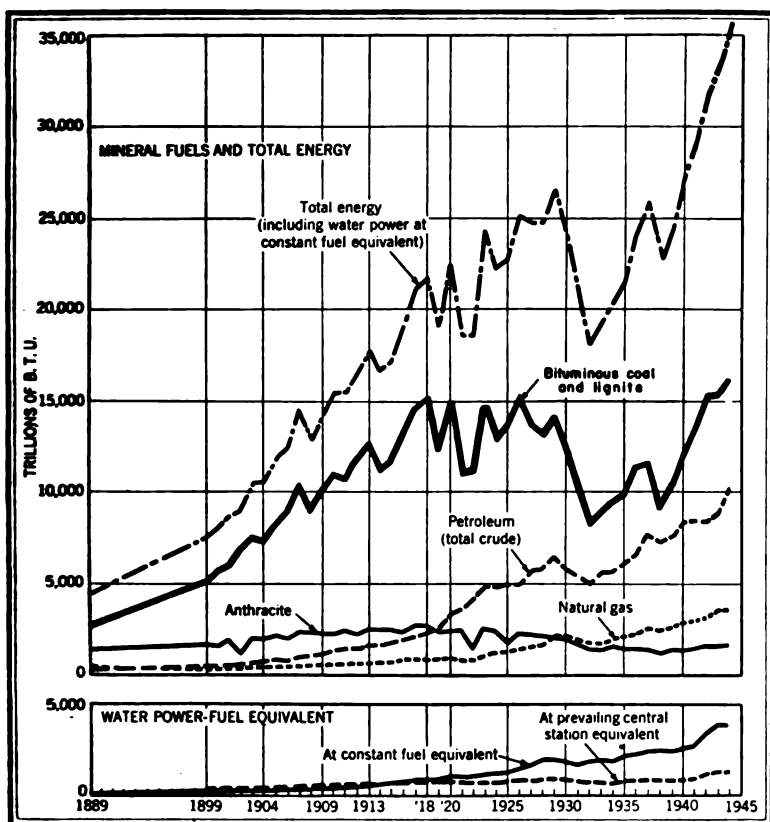


FIGURE 7.—Annual supply of energy from mineral fuels and water power in the United States, 1889-1944

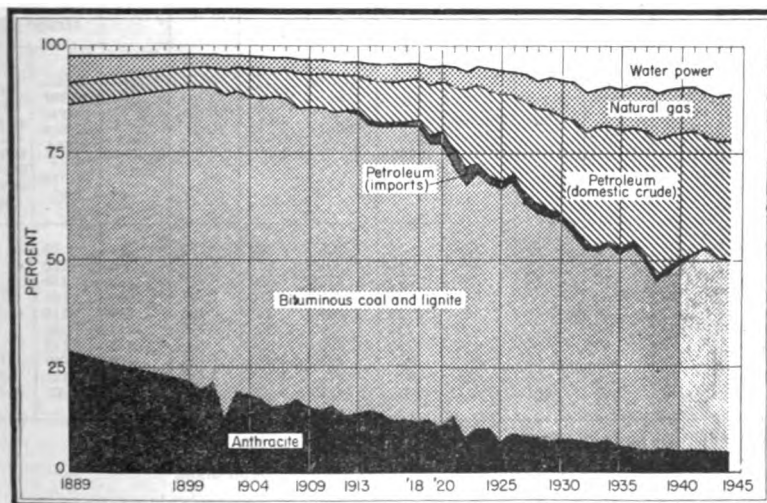


FIGURE 8.—Percentage of total B. t. u. equivalent contributed by the several sources of energy in the United States, counting water power at constant fuel equivalent, 1889-1944. If water power is counted at the prevailing fuel equivalent of central stations in each year, its proportion is 3.2 percent in 1889 and 3.9 percent in 1944, and the proportions of the other sources of energy are affected accordingly.

TABLE 7.—Annual supply of energy from mineral fuels and water power in the United States, 1935-44,¹ in trillions of B. t. u.²

Year	Pennsylvania anthracite	Bituminous coal and lignite	Total coal	Petroleum (total crude, including that refined)		Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power (fuel equivalent)		Grand total energy	
				Domestic production	Imports				At constant fuel equivalent ³	At prevailing central station equivalent ⁴	Water power at constant fuel equivalent	Water power at prevailing central station equivalent
1935.....	1,419	9,756	11,175	5,980	193	2,060	8,233	19,408	2,207	806	21,615	20,214
1936.....	1,485	11,504	12,989	6,508	194	2,330	9,122	22,111	2,256	812	24,367	22,923
1937.....	1,410	11,673	13,083	7,675	165	2,588	10,428	23,511	2,446	871	25,957	24,382
1938.....	1,255	9,132	10,387	7,286	158	2,468	9,912	20,299	2,466	866	22,765	21,165
1939.....	1,400	10,345	11,745	7,590	199	2,663	10,452	22,197	2,423	838	24,620	23,035
1940.....	1,400	12,072	13,472	8,119	256	2,860	11,235	24,707	2,620	880	27,327	25,587
1941.....	1,533	13,471	15,004	8,413	304	3,024	11,741	26,745	2,804	934	29,549	27,679
1942 ⁵	1,641	15,267	16,908	8,320	(⁶)	3,282	11,602	28,510	3,485	1,136	31,995	29,646
1943 ⁵	1,650	15,463	17,113	9,034	(⁶)	3,671	12,705	29,818	3,999	1,304	33,817	31,122
1944 ⁵	1,753	16,244	17,997	10,067	(⁶)	3,654	13,721	31,718	3,989	1,288	35,707	33,006

¹ Comparable data for earlier years in Minerals Yearbook, 1937, p. 807.² The unit heat values employed are: Anthracite, 13,600 B. t. u. per pound; bituminous coal and lignite, 13,100 B. t. u. per pound; petroleum, 6,000,000 B. t. u. per barrel; natural gas, 1,075 B. t. u. per cubic foot. Water power includes installations owned by manufacturing plants and mines, as well as Government and privately owned public utilities. The fuel equivalent of water power is calculated from the kilowatt-hours of power produced wherever available, as is true of all public-utility plants since 1919. Otherwise, the fuel equivalent is calculated from the reported horsepower of installed water wheels, assuming a capacity factor of 20 percent for manufacturers and mines and of 40 percent for public utilities.³ Assuming 4.02 pounds per kilowatt-hour, which is the average of central electric station practice in 1913, the base period used.⁴ Assuming the average central-station practice for each of the years for which data are available, which declined from about 7.05 pounds per kilowatt-hour in 1899 to 1.30 pounds in 1944.⁵ Subject to revision.⁶ Excludes imports of crude petroleum. Figures not available for publication.TABLE 8.—Index numbers for relative rate of growth of coal, oil, and water power in the United States, 1935-44,¹

[Figures expressed as percentage of 1918 rate]

Year	Pennsylvania anthracite	Bituminous coal and lignite	Total coal	Petroleum (total crude)		Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power (at constant fuel equivalent)	Grand total	
				Domestic production	Imports					With water power at constant fuel equivalent	With water power at prevailing central station equivalent
1935.....	53	64	63	280	85	266	262	92	264	99	93
1936.....	55	76	73	309	86	301	291	105	270	112	106
1937.....	52	77	73	359	73	334	332	112	292	119	112
1938.....	47	60	58	341	70	318	316	97	295	104	98
1939.....	52	68	66	355	88	344	333	106	289	113	106
1940.....	52	80	75	380	113	369	358	118	313	125	118
1941.....	57	89	84	394	135	390	374	127	335	135	128
1942 ⁵	61	101	95	390	(⁶)	423	370	136	416	146	137
1943 ⁵	61	102	96	423	(⁶)	474	405	142	478	155	143
1944 ⁵	65	107	101	471	(⁶)	471	437	151	477	163	152

¹ Comparable data for earlier years in Minerals Yearbook, 1937, p. 809.⁵ Subject to revision.⁶ Excludes imports of crude petroleum. Figures not available for publication.

TABLE 9.—Percentage of total B. t. u. equivalent contributed by the several mineral fuels and water power in the United States, 1935-44¹

Year	Penn- syl- vania anthra- cite	Bitu- minous coal and lignite	Total coal	Petroleum (total crude)		Natural gas (total produc- tion)	Total petro- leum and natural gas	Total mineral fuels	Water power fuel equiva- lent	Grand total, includ- ing water power
				Domes- tic produc- tion	Im- ports					
	Water power counted at constant fuel equivalent of approximately 4 pounds per kilowatt-hour									
1935.....	6.6	45.1	51.7	27.7	0.9	9.5	38.1	89.8	10.2	100.0
1936.....	6.1	47.2	53.3	27.1	.8	9.5	37.4	90.7	9.3	100.0
1937.....	5.4	45.0	50.4	29.6	.6	10.0	40.2	90.6	9.4	100.0
1938.....	5.5	40.1	45.6	32.0	.7	10.8	43.5	89.1	10.9	100.0
1939.....	5.7	42.0	47.7	30.8	.8	10.8	42.4	90.1	9.9	100.0
1940.....	5.1	44.2	49.3	29.7	.9	10.5	41.1	90.4	9.6	100.0
1941.....	5.2	45.6	50.8	28.5	1.0	10.2	39.7	90.5	9.5	100.0
1942 ¹	5.1	47.7	52.8	26.0	(²)	10.3	36.3	89.1	10.9	100.0
1943 ¹	4.9	45.7	50.6	26.7	(²)	10.9	37.6	88.2	11.8	100.0
1944 ¹	4.9	45.5	50.4	28.2	(²)	10.2	38.4	88.8	11.2	100.0
	Water power counted at prevailing central-station equivalent for year									
1935.....	7.0	48.3	55.3	29.5	1.0	10.2	40.7	96.0	4.0	100.0
1936.....	6.5	50.2	56.7	28.8	.8	10.2	39.8	96.5	3.5	100.0
1937.....	5.8	47.8	53.6	31.5	.7	10.6	42.8	96.4	3.6	100.0
1938.....	5.9	43.2	49.1	34.4	.7	11.7	46.8	95.9	4.1	100.0
1939.....	6.1	44.9	51.0	32.9	.9	11.6	45.4	96.4	3.6	100.0
1940.....	5.5	47.2	52.7	31.7	1.0	11.2	43.9	96.6	3.4	100.0
1941.....	5.5	48.7	54.2	30.4	1.1	10.9	42.4	96.6	3.4	100.0
1942 ¹	5.5	51.5	57.0	28.1	(²)	11.1	39.2	96.2	3.8	100.0
1943 ¹	5.3	49.7	55.0	29.0	(²)	11.8	40.8	95.8	4.2	100.0
1944 ¹	5.3	49.2	54.5	30.5	(²)	11.1	41.6	96.1	3.9	100.0

¹ Comparable data for earlier years in Minerals Yearbook, 1937, p. 810.² Subject to revision. Percentages based upon figures in table 7.³ Figures not available for publication.

DISTRIBUTION

TABLE 10.—Trends in distribution of bituminous coal and lignite in the United States, 1938-44

[For details and sources of data, see Monthly Report on Distribution of Coal Shipments. Tonnage figures shown in thousands of net tons]

	1938		1939		1940		1941		1942		1943		1944	
	M net tons	Per cent	M net tons	Per cent	M net tons	Per cent	M net tons	Per cent	M net tons	Per cent	M net tons	Per cent	M net tons	Per cent
New England receipts:														
Via rail across the Hudson.....	4,104		4,626		4,892		6,385		9,894		10,365		9,571	
Lake Erie loadings (cargo and fuel):														
By fields of origin:														
From Ohio.....	2,390	6.8	2,356	5.7	2,646	5.5	3,947	7.7	4,171	8.5	4,682	9.9	4,995	9.0
From Pittsburgh and other Pennsylvania.....	8,019	22.8	9,259	22.5	11,578	24.1	11,612	22.6	9,305	18.8	8,409	17.7	10,568	19.0
From Mountsville, Fairmont, and Cumberland-Piedmont.....	1,389	4.0	1,963	4.8	2,357	4.9	2,963	5.8	2,778	5.6	2,763	5.8	3,678	6.6
From Southern West Virginia:														
High volatile.....	8,329	23.7	10,883	26.5	12,025	25.0	14,277	27.8	14,746	29.8	14,256	30.1	13,902	25.1
Low volatile.....	7,612	21.7	8,665	21.1	10,372	21.6	9,010	17.5	9,160	18.5	8,653	18.2	10,797	19.5
From East Kentucky, Tennessee, and Virginia.....	7,392	21.0	7,998	19.4	9,133	18.9	9,585	18.6	9,295	18.8	8,692	18.3	11,551	20.8
Total.....	35,131	100.0	41,124	100.0	48,111	100.0	51,394	100.0	49,455	100.0	47,455	100.0	55,491	100.0
By destinations (cargo only):														
To American points.....	27,656	80.9	33,188	83.3	37,894	81.2	38,823	78.1	36,267	75.9	34,146	74.1	41,773	77.4
To Canadian points.....	6,510	19.1	6,672	16.7	8,778	18.8	10,886	21.9	11,544	24.1	11,939	25.9	12,210	22.6
Total.....	34,166	100.0	39,860	100.0	46,532	100.0	49,709	100.0	47,811	100.0	46,085	100.0	53,983	100.0
Across Lake Michigan car ferry.....	588		592		612		627		740		769		645	
West-bound rail to Mississippi Valley (revenue all-rail shipments, excluding railroad fuel, Lake coal, and movements to Kentucky points):														
From Ohio fields.....	8,042	8.7	9,052	8.4	9,807	8.0	10,846	7.9	11,719	7.4	12,679	7.6	14,289	8.3
From Pennsylvania fields.....	9,620	10.4	12,200	11.4	15,195	12.4	16,663	12.1	18,141	11.5	18,189	11.0	19,175	11.2
From Northern West Virginia and Cumberland-Piedmont.....	2,615	2.8	3,227	3.0	3,467	2.8	4,728	3.4	5,201	3.3	6,268	3.8	7,728	4.5
From Southern West Virginia:														
High volatile.....	13,668	14.8	15,099	14.0	16,943	13.8	18,275	13.3	21,500	13.6	22,739	13.6	22,222	13.0
Low volatile.....	13,335	14.5	15,946	14.8	19,536	15.9	22,773	16.6	25,005	15.9	24,477	14.7	21,717	12.7
From East Kentucky, Tennessee, and Virginia.....	14,120	15.3	15,749	14.7	18,340	14.9	18,980	13.8	22,770	14.4	23,010	13.8	20,921	12.2
Total from Appalachian fields.....	61,400	66.5	71,273	66.3	83,288	67.8	92,265	67.1	104,336	66.1	107,362	64.5	106,052	61.9

From Illinois.....	20,719	22.5	34,275	23.1	37,613	22.5	30,100	21.0	34,002	23.4	43,230	22.4	46,240	27.0
From Indiana.....	8,111	1.8	1,917	4.5	10,223	4.3	12,499	9.0	14,031	4.0	13,090	4.0	12,408	2.0
From Kentucky.....	1,001	1.8	1,917	1.8	1,768	1.4	2,735	2.0	2,568	1.0	2,190	1.0	2,408	2.0
Total from Middle West fields.....	30,881	33.6	36,221	33.7	39,599	32.2	45,334	32.9	53,570	33.0	59,201	33.5	65,219	38.1
Grand total.....	92,281	100.0	107,524	100.0	122,837	100.0	137,599	100.0	157,915	100.0	166,563	100.0	171,271	100.0
Total shipments from other groups (all shipments, including, in this case, nonrevenue railroad fuel): ¹														
From Michigan fields.....	166	(²)	122	(²)	103	(²)	120	(²)	71	(²)	56	(²)	57	(²)
From upper Lake commercial docks, all deliveries.....	10,845	3.1	11,111	3.8	12,054	2.6	12,473	2.4	14,036	2.4	15,867	2.7	14,165	2.3
From Iowa, Missouri, Kansas.....	6,528	1.0	6,068	1.5	6,411	1.7	6,731	1.3	7,361	1.3	8,246	1.4	8,290	1.3
From Arkansas, Oklahoma, Texas.....	8,126	1.0	2,046	1.7	3,394	4.7	3,411	1.7	4,345	1.7	4,226	1.7	4,415	1.7
From Far West fields.....	17,612	5.1	18,442	4.7	19,658	4.3	20,009	4.3	27,154	4.7	28,724	4.9	29,855	4.8
From Alabama field.....	10,382	3.0	11,233	2.8	14,288	3.1	14,310	2.8	17,525	3.0	16,270	2.8	17,928	2.9

¹ Excluding commercial sales by truck and wagon, except from upper Lake docks.

² Percent of total national shipments from all mines, all destinations.

³ Less than 0.1 percent.

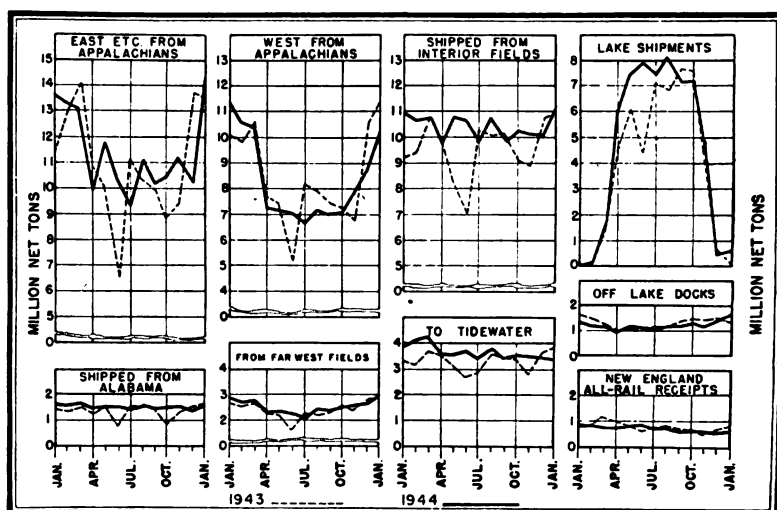


FIGURE 9.—Monthly movement of bituminous coal and lignite in the United States in the major channels of distribution, 1943-44.

STOCKS HELD BY CONSUMERS

TABLE 11.—Stocks of bituminous coal and lignite in hands of commercial consumers and in retail dealers' yards in the United States, 1943-44

Date	Total stocks (net tons)	Days' supply at current rate of consumption on date of stock taking								
		By- product coke plants	Steel plants	Other indus- trial	Coal- gas plants	Elec- tric utili- ties	Retail yards	Rail- roads	Cement mills	Total
1943										
Jan. 1.....	85,889,000	44	34	69	88	101	28	35	48	51
Feb. 1.....	79,379,000	40	32	64	82	100	21	31	46	46
Mar. 1.....	76,626,000	39	29	60	76	99	18	30	42	44
Apr. 1.....	77,292,000	40	33	63	75	100	18	32	46	45
May 1.....	78,667,000	39	37	66	81	108	21	37	50	49
June 1.....	79,525,000	37	39	78	84	113	28	39	47	54
July 1.....	74,075,000	30	36	81	84	94	27	36	42	52
Aug. 1.....	75,570,000	28	33	84	85	89	28	38	40	52
Sept. 1.....	75,276,000	27	34	85	91	85	22	40	43	49
Oct. 1.....	72,866,000	26	33	78	92	81	15	39	47	45
Nov. 1.....	68,791,000	27	29	66	83	75	15	35	48	42
Dec. 1.....	60,079,000	24	22	52	65	69	16	28	43	36
Dec. 31.....	56,686,000	25	22	43	60	61	12	25	42	30
1944										
Jan. 1.....	56,686,000	25	22	43	60	61	12	25	42	30
Feb. 1.....	53,628,000	24	23	42	54	59	12	24	54	30
Mar. 1.....	52,720,000	24	22	38	47	60	13	24	52	29
Apr. 1.....	51,835,000	24	23	38	45	66	12	25	55	30
May 1.....	50,513,000	22	26	40	44	79	11	27	56	32
June 1.....	55,293,000	22	28	51	50	83	19	34	50	39
July 1.....	59,680,000	24	30	56	55	80	21	39	47	42
Aug. 1.....	61,413,000	22	32	64	57	82	23	42	50	44
Sept. 1.....	63,909,000	23	29	62	64	77	18	43	47	43
Oct. 1.....	64,905,000	24	29	59	62	80	18	44	49	43
Nov. 1.....	65,074,000	25	28	52	59	82	17	42	50	41
Dec. 1.....	64,020,000	26	26	44	61	78	17	40	49	39
Dec. 31.....	57,204,000	24	21	39	55	72	11	34	47	32

POSTWAR OUTLOOK

The postwar outlook for soft coal revolves around the general level of industrial activity and the extent of competition offered by other fuels. The consumption of soft coal follows very closely the trend of industry, as only a small fraction of the total is used for domestic space-heating. The accumulated demand for many products, particularly for automobiles, machinery, building materials, and household appliances, doubtless will stimulate industry for several years after the war closes. However, it is expected that inroads on coal by competitive fuels will be resumed.

Soft coal will be in a vulnerable competitive position very soon. The shortage of coal has already resulted in some reconversion to fuel oil. A very rapid expansion of natural-gas consumption is anticipated as soon as pipe becomes available. Plans are already under way for vast hydroelectric developments after the war. It is not too early for the soft-coal industry to begin to prepare itself for the inevitable postwar competitive struggle.

FINAL BITUMINOUS-COAL AND LIGNITE STATISTICS FOR 1943

Tables 12 to 49 give the final detailed statistics of bituminous-coal and lignite-mine operations in 1943. The subjects covered include production, number and size of mines, employment, value, mechanization, exports, and world production.

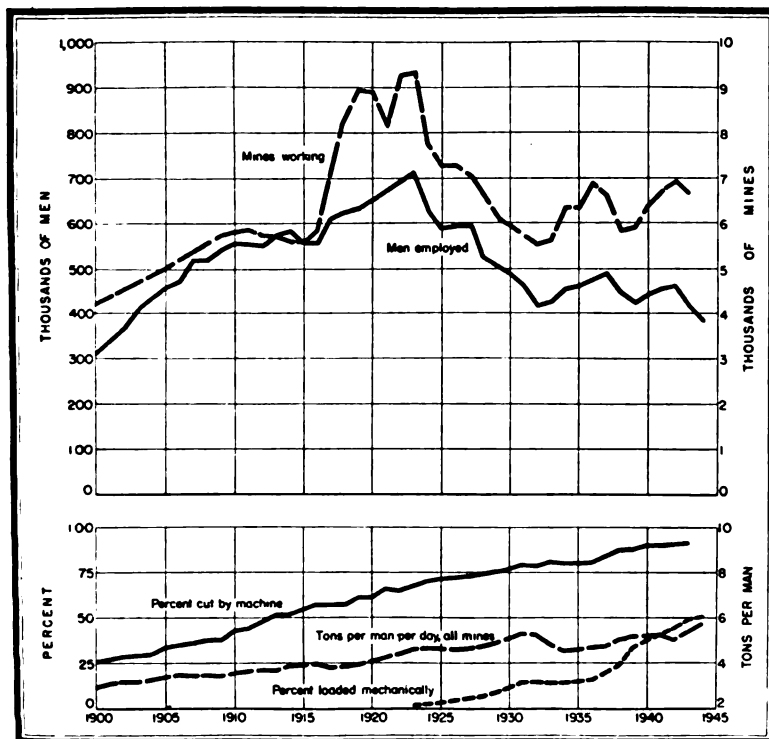


Figure 10.—Trends of employment, mechanization, and output per man at bituminous-coal and lignite mines in the United States, 1900-1944.

SALIENT TRENDS

TABLE 12.—Salient trends in bituminous-coal- and lignite-mining industry in the United States, 1936-43

	1936	1937	1938	1939	1940	1941	1942	1943
Production:								
Loaded at mine for shipment by rail.....net tons.....	370,762,901	1,399,237,575	295,338,027	331,189,020	380,387,674	425,184,319	452,814,042	495,863,581
Loaded at mine for shipment by water.....do.....	24,867,683	(1)	16,902,969	22,229,364	29,493,058	30,240,489	34,018,025	30,188,003
Shipped by truck or wagon.....do.....	27,920,288	*37,762,612	23,592,058	29,533,824	35,540,476	40,055,638	45,154,432	42,432,667
Taken by locomotive tenders at tipple.....do.....	(1)	(2)	606,857	29,533,824	35,540,476	1,090,582	920,213	779,154
Shipped by conveyor or tram to point of consumption do.....do.....	(1)	(2)	4,221,671	4,317,465	5,887,958	6,067,697	7,121,116	7,476,717
Used by mine employees.....do.....	*9,571,967	(3)	2,032,289	1,901,408	2,035,201	1,872,026	2,180,077	2,549,775
Used at mines for power and heat.....do.....	3,227,447	3,032,095	2,493,017	2,565,276	2,442,989	2,488,950	2,708,312	2,701,828
Made into beehive coke at mines.....do.....	2,728,577	4,884,054	1,359,876	2,089,475	4,045,050	7,140,544	7,776,720	8,185,254
Total production.....do.....	439,087,903	4,445,531,449	348,544,764	*394,855,325	460,771,500	514,149,245	582,692,937	590,177,069
Number of active mines of commercial size:								
Class 1 (200,000 tons or more).....number.....	660	661	526	577	636	730	811	855
Class 2 (100,000 to 200,000 tons).....do.....	432	469	402	404	432	437	484	464
Class 3 (50,000 to 100,000 tons).....do.....	460	448	415	387	371	402	445	481
Class 4 (10,000 to 50,000 tons).....do.....	1,085	1,117	1,042	1,065	1,157	1,305	1,492	1,544
Class 5 (1,000 to 10,000 tons).....do.....	4,218	3,853	3,392	3,387	3,728	3,948	3,740	3,276
Total number over 1,000 tons.....do.....	6,875	6,548	5,777	5,820	6,324	6,822	6,972	6,620
Average number of men employed at mines active:								
Underground.....men.....	399,367	(4)	370,004	353,476	365,013	376,765	374,654	328,763
Surface.....do.....	8,043	(5)	7,877	8,791	8,983	10,861	12,893	16,643
All others.....do.....	69,794	(6)	63,452	59,521	65,079	69,355	74,444	72,601
Total.....do.....	477,204	491,864	441,333	421,788	439,075	456,981	461,991	416,007
Average number of days mines operated.....days.....	199	193	162	178	202	216	246	264
Capacity of active mines with existing labor force:								
Per year of 308 days.....net tons.....	680,000,000	710,000,000	683,000,000	683,000,000	703,000,000	733,000,000	730,000,000	689,000,000
Per year of 280 days.....do.....	618,000,000	646,000,000	622,000,000	621,000,000	639,000,000	666,000,000	663,000,000	626,000,000
Per year of 261 days.....do.....	576,000,000	601,000,000	562,000,000	579,000,000	595,000,000	621,000,000	618,000,000	583,000,000
Output per man per day.....do.....	4.62	4.69	4.89	6.25	5.19	6.20	6.12	6.38
Output per man per year.....do.....	920	906	790	936	1,049	1,125	1,261	1,419
Underground output cut by machine.....do.....	348,332,330	(7)	278,315,365	313,969,394	369,227,277	408,510,296	462,344,719	461,051,743
Percent of underground output cut by machine.....percent.....	84.8	(8)	87.5	87.9	88.4	89.0	89.7	90.3
Underground output mechanically loaded.....net tons.....	66,976,872	83,500,000	85,092,836	110,711,970	147,870,252	186,067,250	232,902,920	249,805,214
Percent of underground output mechanically loaded.....percent.....	16.3	20.2	24.7	31.0	35.4	40.7	45.2	48.9

Quantity mined by stripping.....	net tons	28,123,857	31,750,553	20,405,855	37,772,553	43,157,336	55,071,000	67,302,003	79,865,176
Percent mined by stripping.....	percent	6.4	7.1	8.7	9.6	9.4	10.7	11.3	13.6
Quantity cleaned by wet or pneumatic processes.....	net tons	61,094,976	65,000,000	63,454,583	79,429,426	102,290,753	117,539,822	142,157,340	145,575,949
Percent cleaned by wet or pneumatic processes.....	percent	13.9	14.6	13.2	20.1	22.2	21.9	24.4	24.7

† The total production differs from sum of items shown by amount of changes in inventory and tonnage not accounted for in distribution analysis. This amounted to 596,113 tons.

‡ Includes 202,337 tons of coal reported as net changes in stocks at mines, Jan. 1, 1939, to Jan. 1, 1940.
 § Data not available.
 ¶ Includes central washeries operated by consumers.

‡ In 1937, coal loaded at mine for shipment by water is included with "Loaded at mine for shipment by rail."
 § Coal "Taken by locomotive tenders at tippie," "Shipped by conveyor or tram to point of consumption," and "Used by mine employees" included with "Shipped by truck or wagon."
 ¶ In 1936 data were not collected in such form as to permit a separation of coal "Taken by locomotive tenders at tippie," "Shipped by conveyor or tram to point of consumption," and "Used by mine employees." They are all included here under "Used by mine employees."

TABLE 13.—*Growth of the bituminous-coal- and lignite-mining industry in the United States, 1890-1943*

Year	Production (net tons)	Value		Men em- ployed	Num- ber of mines	Calculated capacity (millions of net tons)—		
		Total ¹	Aver- age per ton ¹			At 308 days	At 280 days	At 261 days
1890.....	111,302,322	\$110,420,801	\$0.99	192,204	(?)	152	137	129
1891.....	117,901,238	117,188,400	.99	205,803	(?)	163	148	138
1892.....	126,856,567	125,124,381	.99	212,893	(?)	178	162	151
1893.....	128,385,231	122,751,618	.96	230,365	(?)	194	174	164
1894.....	118,820,405	107,653,501	.91	244,603	(?)	214	196	181
1895.....	135,118,193	115,779,771	.86	239,962	2,555	215	196	182
1896.....	137,640,276	114,891,515	.83	244,171	2,599	221	202	187
1897.....	147,617,519	119,595,224	.81	247,817	2,454	232	213	197
1898.....	166,593,623	132,608,713	.80	255,717	2,862	243	221	206
1899.....	193,323,187	167,952,104	.87	271,027	3,245	254	230	216
1900.....	212,316,112	220,930,313	1.04	304,375	(?)	279	255	237
1901.....	225,828,149	236,422,049	1.05	340,235	(?)	309	281	262
1902.....	260,216,844	290,858,483	1.12	370,056	(?)	348	316	295
1903.....	282,749,348	351,687,933	1.24	415,777	(?)	387	350	328
1904.....	278,659,689	305,397,001	1.10	437,832	4,650	425	386	360
1905.....	315,062,785	334,658,294	1.06	460,629	5,060	460	417	390
1906.....	342,874,867	381,162,115	1.11	478,425	4,430	496	451	420
1907.....	394,759,112	451,214,842	1.14	513,258	4,550	520	473	440
1908.....	332,673,944	374,135,268	1.12	516,264	4,730	531	482	450
1909.....	379,744,257	405,486,777	1.07	543,152	5,775	560	510	474
1910.....	417,111,142	469,281,719	1.12	555,533	5,818	592	538	502
1911.....	405,907,059	451,375,819	1.11	549,775	5,887	593	538	502
1912.....	450,104,982	517,983,445	1.15	548,632	5,747	622	566	527
1913.....	478,435,297	565,234,952	1.18	571,882	5,776	635	577	538
1914.....	422,703,970	493,309,244	1.17	583,506	5,592	668	608	566
1915.....	442,624,426	502,037,688	1.13	557,456	5,502	672	610	569
1916.....	502,519,682	665,116,077	1.32	561,102	5,726	673	613	570
1917.....	551,790,563	1,249,272,837	2.26	603,143	6,939	699	636	593
1918.....	579,385,820	1,491,809,940	2.58	615,305	8,319	717	650	607
1919.....	465,860,058	1,160,616,013	2.49	621,998	8,994	736	669	624
1920.....	568,666,683	2,129,933,000	3.75	639,547	8,921	796	725	676
1921.....	415,921,950	1,199,983,600	2.89	663,754	8,038	860	781	729
1922.....	422,268,099	1,274,820,000	3.02	687,958	9,299	916	832	776
1923.....	564,564,662	1,514,621,000	2.68	704,793	9,331	970	885	823
1924.....	483,686,538	1,062,626,000	2.20	619,604	7,586	871	792	738
1925.....	520,052,741	1,060,402,000	2.04	588,493	7,144	822	748	696
1926.....	573,366,985	1,183,412,000	2.06	593,647	7,177	821	747	696
1927.....	517,763,352	1,029,657,000	1.99	593,918	7,011	835	759	708
1928.....	500,744,970	933,774,000	1.86	522,150	6,450	760	691	644
1929.....	534,988,593	952,781,000	1.78	502,993	6,057	752	679	638
1930.....	467,526,299	795,483,000	1.70	493,202	5,891	770	700	658
1931.....	382,089,396	588,895,000	1.54	450,213	5,642	736	669	623
1932.....	309,709,872	406,677,000	1.31	406,380	5,427	653	594	554
1933.....	333,630,533	445,788,000	1.34	418,703	5,555	615	559	521
1934.....	359,368,022	628,383,000	1.75	458,011	6,258	622	565	527
1935.....	372,373,122	658,063,000	1.77	462,403	6,315	640	582	543
1936.....	439,087,903	770,955,000	1.76	477,204	6,875	680	618	576
1937.....	445,531,449	864,042,000	1.94	491,864	6,548	710	646	601
1938.....	348,544,764	678,653,000	1.95	441,333	5,777	663	602	562
1939.....	394,855,325	728,348,366	1.84	421,788	5,820	683	621	579
1940.....	460,771,500	879,327,227	1.91	439,076	6,324	703	639	595
1941.....	514,149,245	1,125,362,836	2.19	456,981	6,822	733	666	621
1942.....	582,692,937	1,373,990,608	2.36	461,991	6,972	730	663	618
1943.....	590,177,069	1,584,644,477	2.69	416,007	6,620	689	626	583

¹ Figures on value and value per ton for years 1890 to 1936, inclusive, and 1939, exclude selling expense. Figures for other years include selling expense.

² Data not available.

TABLE 13.—*Growth of the bituminous-coal- and lignite-mining industry in the United States, 1890-1943—Continued*

Year	Average number of days worked	Average number of days lost on account of strikes—		Net tons per man—		Percent of underground production—		Percent of total production—	
		Per man employed	Per man on strike	Per day	Per year	Cut by machines ⁽¹⁾	Mechanically loaded	Mechanically cleaned ⁴	Mined by strip-ping
1890.....	226	(²)	(²)	2.56	579	(²)	(²)	(²)	(²)
1891.....	223	(²)	(²)	2.57	573	5.3	(²)	(²)	(²)
1892.....	219	(²)	(²)	2.72	596	(²)	(²)	(²)	(²)
1893.....	204	(²)	(²)	2.73	557	(²)	(²)	(²)	(²)
1894.....	171	(²)	(²)	2.84	486	(²)	(²)	(²)	(²)
1895.....	194	(²)	(²)	2.90	563	(²)	(²)	(²)	(²)
1896.....	192	(²)	(²)	2.94	564	11.9	(²)	(²)	(²)
1897.....	196	(²)	(²)	3.04	596	15.3	(²)	(²)	(²)
1898.....	211	(²)	(²)	3.09	651	19.5	(²)	(²)	(²)
1899.....	234	8	46	3.05	713	22.7	(²)	(²)	(²)
1900.....	234	5	43	2.98	697	24.9	(²)	(²)	(²)
1901.....	225	2	35	2.94	664	25.6	(²)	(²)	(²)
1902.....	230	7	44	3.06	703	26.8	(²)	(²)	(²)
1903.....	225	3	28	3.02	680	27.6	(²)	(²)	(²)
1904.....	202	8	44	3.15	637	28.2	(²)	(²)	(²)
1905.....	211	2	23	3.24	684	32.8	(²)	(²)	(²)
1906.....	213	28	63	3.36	717	34.7	(²)	2.7	(²)
1907.....	234	1	14	3.29	769	35.1	(²)	2.9	(²)
1908.....	193	11	38	3.34	644	37.0	(²)	3.6	(²)
1909.....	209	1	29	3.34	699	37.5	(²)	3.8	(²)
1910.....	217	35	89	3.46	751	41.7	(²)	3.8	(²)
1911.....	211	2	27	3.50	738	43.9	(²)	(²)	(²)
1912.....	223	10	35	3.68	820	46.8	(²)	3.9	(²)
1913.....	232	4	36	3.61	837	50.7	(²)	4.6	(²)
1914.....	195	19	80	3.71	724	51.8	(²)	4.8	0.3
1915.....	203	4	61	3.91	794	55.3	(²)	4.7	.6
1916.....	230	4	26	3.90	896	56.9	(²)	4.6	.8
1917.....	243	4	17	3.77	915	56.1	(²)	4.6	1.0
1918.....	249	1	7	3.78	942	56.7	(²)	3.8	1.4
1919.....	195	25	37	3.84	749	60.0	(²)	3.6	1.2
1920.....	220	6	22	4.00	881	60.7	(²)	3.3	1.5
1921.....	149	3	23	4.20	627	66.4	(²)	3.4	1.2
1922.....	142	78	117	4.28	609	64.8	(²)	(²)	2.4
1923.....	179	2	20	4.47	801	68.3	0.3	3.8	2.1
1924.....	171	7	73	4.56	781	71.5	.7	(²)	2.8
1925.....	195	2	30	4.52	884	72.9	1.2	(²)	3.2
1926.....	215	1	24	4.50	966	73.8	1.8	(²)	3.0
1927.....	191	45	153	4.55	872	74.9	(²)	5.3	3.6
1928.....	203	8	83	4.73	959	76.9	4.5	5.7	4.0
1929.....	219	(²)	11	4.85	1,064	78.4	7.4	6.9	3.8
1930.....	187	2	43	5.06	948	81.0	10.5	8.3	4.3
1931.....	180	3	35	5.30	849	83.2	13.1	9.5	5.0
1932.....	146	19	120	5.22	762	84.1	12.3	9.8	6.3
1933.....	167	9	30	4.78	797	84.7	12.0	10.4	5.5
1934.....	178	3	15	4.40	785	84.1	12.2	11.1	5.8
1935.....	179	(²)	(²)	4.50	805	84.2	13.5	12.2	6.4
1936.....	199	2	21	4.62	920	84.8	16.3	13.9	6.4
1937.....	193	(²)	(²)	4.69	906	(²)	20.2	14.6	7.1
1938.....	162	1	13	4.89	790	87.5	26.7	18.2	8.7
1939.....	178	25	36	5.25	936	87.9	31.0	20.1	9.6
1940.....	202	1	8	5.19	1,049	88.4	35.4	22.2	9.4
1941.....	216	20	27	5.20	1,125	89.0	40.7	22.9	10.7
1942.....	246	1	7	5.12	1,261	89.7	45.2	24.4	11.5
1943.....	264	(²)	(²)	5.38	1,419	90.3	48.9	24.7	13.5

¹ Data not available.² Percentages for years 1890 to 1913, inclusive, are of total production, as separation of strip-mine and underground production not available for those years.³ For years 1906 to 1926, inclusive, percentages are exclusive of coal cleaned at central washeries operated by consumers; after 1926, when data became available on tonnage cleaned by consumer-operated plants, percentages include total tons cleaned at mines and at consumer-operated washeries.⁴ One-half day or less.

TABLE 14.—Coal produced in the United States, by States, 1933-43, with production of maximum year and cumulative production from earliest record to end of 1943, in thousands of net tons

State	Maximum production		Production by years										Total production from earliest record to end of 1943	
	Year	Quantity	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942		1943
Alabama.....	1926	21,001	8,760	9,142	8,505	12,229	12,440	11,062	12,047	15,324	15,464	19,301	17,160	718,324
Arkansas.....	1907	2,670	883	857	1,133	1,623	1,511	1,197	1,523	1,454	1,374	1,985	1,718	81,424
Colorado.....	1917	12,483	5,230	5,211	5,911	6,812	7,187	5,663	5,923	6,589	6,949	8,086	8,324	432,763
Georgia.....	1903	416	41	33	(1)	(1)	(1)	(1)	(1)	(1)	(1)	31	14	(1)
Illinois.....	1918	89,291	37,413	41,272	44,325	50,927	51,602	41,912	46,783	50,610	54,703	65,071	72,631	2,737,601
Indiana.....	1918	30,679	13,761	14,794	15,754	17,822	17,765	14,759	16,943	18,869	22,484	23,888	23,065	844,988
Iowa.....	1917	8,966	3,195	3,367	3,650	3,961	3,637	3,103	2,943	3,251	2,839	2,948	2,771	326,679
Kansas.....	1918	7,562	2,218	2,508	2,686	2,944	2,893	2,654	2,675	3,579	4,008	4,230	3,457	246,647
Kentucky.....	1927	69,124	36,100	38,525	40,761	47,522	47,086	38,545	42,557	49,141	53,710	62,231	63,211	1,519,364
Maryland.....	1907	5,533	1,531	1,627	1,678	1,704	1,549	1,281	1,443	1,503	1,701	2,001	1,953	249,809
Michigan.....	1907	2,036	407	622	628	626	662	494	457	410	311	231	169	45,988
Missouri.....	1917	5,671	3,432	3,352	3,646	3,985	4,091	3,436	3,273	3,097	3,145	3,520	4,310	233,067
Montana (bituminous and lignite).....	1943	4,833	2,152	2,566	2,759	2,988	2,965	2,732	2,804	3,254	3,529	4,833	4,833	135,387
New Mexico.....	1918	4,023	1,226	1,259	1,389	1,597	1,715	1,239	1,230	1,111	1,251	1,669	1,851	113,121
North Carolina.....	1922	79	2	3	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
North Dakota (lignite).....	1942	2,537	1,782	1,754	1,956	2,215	2,251	2,050	2,072	2,218	2,309	2,537	2,500	51,509
Ohio.....	1920	46,878	19,589	20,691	21,153	24,110	25,178	18,591	20,289	22,772	25,319	32,764	32,255	1,491,537
Oklahoma.....	1920	4,849	1,238	1,205	1,229	1,540	1,600	1,245	1,188	1,646	1,771	2,387	2,838	140,105
Pennsylvania (bituminous).....	1918	178,551	79,296	89,826	91,405	109,887	111,002	77,705	92,834	116,603	130,240	144,073	141,050	6,590,441
Tennessee.....	1942	8,158	3,775	4,136	4,138	5,213	5,213	4,472	5,185	6,008	7,045	8,158	7,179	288,244
Texas (bituminous and lignite).....	1913	2,429	822	759	738	843	910	879	826	621	353	304	153	60,499
Utah.....	1943	6,666	2,675	2,406	2,947	3,247	3,810	2,947	3,285	3,576	4,077	5,517	6,666	157,672
Virginia.....	1943	20,280	8,179	9,377	9,667	11,662	13,795	12,283	13,531	15,348	18,441	20,136	20,280	449,093
Washington.....	1918	4,082	1,394	1,383	1,559	1,812	2,002	1,567	1,690	1,650	1,841	1,933	1,528	135,340
West Virginia.....	1943	158,804	94,344	98,134	99,179	117,926	118,646	93,288	108,362	126,438	140,250	165,882	158,804	4,033,355
Wyoming.....	1920	9,680	4,013	4,368	5,177	5,781	5,918	5,204	5,373	6,808	6,646	8,133	9,155	315,975
Other States.....	-----	-----	173	188	180	217	203	237	235	299	364	328	342	63,308
Total bituminous and lignite.....	1943	590,177	333,631	359,368	372,373	439,088	445,831	348,545	394,855	460,772	514,149	582,093	590,177	21,464,880
Pennsylvania anthracite.....	1917	99,612	49,541	57,168	52,159	54,580	51,856	46,099	51,487	51,485	56,368	60,328	60,644	4,562,769
Grand total.....	-----	-----	383,172	416,536	424,532	493,668	497,387	394,644	446,342	512,257	570,517	643,021	650,821	26,027,649

¹ Included under "Other States."

SUMMARY BY STATES AND DISTRICTS
TABLE 15.—Number of mines, production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States, in 1943
 [Exclusive of mines producing less than 1,000 tons]

State	Num-ber of active mines	Disposition of coal produced (net tons)										Average number of employees				Aver-age num-ber of days mines were active	Number of man-days worked	Aver-age tons per man per day
		Loaded at mine di-rectly into railroad cars or river barges	Hauled by truck to railroad siding for shipment by railroad or by water-way for shipment by water	Shipped by truck or wagon (exclud-ing coal used by mines employ-ees)	Taken by loco-mo-tive tenders at tipples	Shipped by con-veyor or train to point of con-sump-tion	Used by mines employ-ees	Used at mines for power and heat and made into beet-licoleat mines	Total quantity	Aver-age value per ton	Surface		Total					
											Under-ground	In strip pits		All others				
Alabama.....	286	14,880,428	1,811,120	938,539	63,084	283,652	87,972	96,525	17,100,320	\$3.45	19,287	287	3,720	23,274	253	5,881,131	2.92	
Alaska.....	5	284,143	4,400	2,777	1,831	.....	.....	16,581	289,232	6.37	172	.....	79	251	321	80,864	3.59	
Arizona.....	3	.....	.....	11,156	.....	.....	128	.....	11,281	2.63	28	.....	5	31	209	6,491	1.74	
Arkansas.....	66	1,240,373	397,023	71,742	.....	.....	4,771	4,028	1,717,935	4.18	2,247	164	429	2,830	197	557,512	3.08	
Colorado.....	176	6,054,281	352,925	1,519,647	10,245	58,029	48,966	\$ 280,070	8,324,192	3.31	5,990	11	1,446	7,447	253	1,961,782	4.24	
Georgia.....	1	13,632	.....	.....	.....	.....	363	380	14,355	3.78	50	.....	10	60	266	16,960	.90	
Illinois.....	349	62,839,668	1,737,267	7,557,077	24,464	235,753	310,125	926,316	72,631,270	2.13	23,473	1,745	7,148	32,866	257	8,329,034	8.72	
Indiana.....	196	21,196,267	903,884	2,333,783	7,873	463,277	27,533	131,966	26,084,563	2.09	5,907	1,953	2,844	10,704	241	2,978,817	9.72	
Iowa.....	170	765,962	646,503	1,420,803	.....	.....	26,325	11,027	2,770,610	3.10	2,968	235	492	3,725	196	729,498	3.80	
Kansas.....	69	3,037,632	18,993	321,565	17,633	35,219	6,280	17,092	3,436,781	2.50	843	673	490	2,006	229	458,516	7.80	
Kentucky.....	955	56,481,476	2,728,767	3,127,510	17,633	380,744	289,976	\$ 185,367	63,211,473	2.70	43,060	470	8,418	51,948	258	13,388,267	4.72	
Maryland.....	100	1,417,451	153,517	347,408	3,865	.....	7,664	3,575	1,933,380	3.01	1,641	74	355	2,070	249	515,923	3.75	
Michigan.....	5	57,141	.....	98,848	.....	.....	3,113	9,513	1,085,615	4.87	1,240	.....	38	278	257	71,472	2.36	
Missouri.....	128	3,052,834	72,467	1,154,080	.....	.....	10,142	20,113	4,309,636	2.50	1,590	720	642	2,952	224	690,493	6.24	
Montana.....	35	4,534,880	64,280	150,938	652	.....	14,017	3,893	4,708,660	1.74	844	85	366	1,265	273	353,776	13.48	
Bituminous.....	15	.....	.....	64,198	.....	.....	(¹)	4,183	64,383	2.16	46	6	14	66	182	12,038	6.35	
Lignite.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
Total Mon-tana.....	50	4,534,880	64,280	215,136	652	.....	14,017	4,078	4,833,049	1.75	890	91	380	1,361	269	365,814	13.21	
New Mexico.....	32	1,652,938	40,695	110,991	.....	.....	8,870	37,633	1,850,827	3.53	1,477	.....	526	2,003	285	570,148	3.25	
North Dakota (lig-nite).....	106	1,599,369	(¹)	516,778	(¹)	46,315	(¹)	27,740	2,600,202	1.50	405	324	273	1,002	223	223,777	11.17	
Ohio.....	592	23,520,687	2,530,085	6,026,545	884	38,685	66,906	68,301	32,254,963	2.42	14,268	1,974	4,042	20,222	254	5,144,929	6.37	
Oklahoma.....	82	2,283,411	346,905	167,673	5,963	.....	2,199	18,196	2,837,347	3.16	1,650	318	632	2,600	233	668,967	4.31	
Oregon.....	1	1,150	.....	.....	.....	.....	.....	.....	1,200	4.00	5	.....	1	6	140	68,840	1.43	
Pennsylvania.....	1,834	101,458,292	14,927,879	12,548,264	199,351	3,958,285	577,031	\$ 7,380,712	141,049,834	2.82	84,600	5,503	15,713	105,816	266	28,188,796	5.01	
South Dakota (lig-nite).....	7	.....	.....	.....	.....	.....	476	(¹)	40,664	1.92	4	21	4	29	203	5,890	6.90	
Tennessee.....	180	6,230,627	19,852	20,737	31,870	.....	83,053	\$ 26,481	7,178,918	2.83	6,761	15	1,160	7,926	239	1,968,082	3.78	

See footnotes at end of table.

TABLE 15.—*Number of mines, production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States, in 1943—Continued*
 [Exclusive of coal mines producing less than 1,000 tons]

State	Num-ber of active mines	Disposition of coal produced (net tons)										Average value per ton 2	Average number of employees			Average number of days mines were active	Number of man-days worked	Aver- age tons per man per day
		Loaded at mine di- rectly into railroad cars or barges	Hauled by truck to railroad siding for shipment by rail and to water- way for shipment by water 1	Shipped by truck or wagon (exclud- ing coal mined by employ-ees)	Taken by com- oti- ve tenders at tipple	Shipped by con- veyor or tram to point of con- shipment	Used by mine employ-ees	Used at mines for power and heat and made into beehive coke at mines 2	Total quantity	Surface			Total					
										Under- ground	In strip pits			All others				
Texas:	1	7,562		1,535					9,097	\$4.32	21	5	26	250	6,500	1.40		
Bituminous	3	140,826		(1)	4 3,318				144,144	.80	844	14	10	68	8,762	16.45		
Lignite																		
Total Texas	4	148,388		1,535	3,318				153,241	1.09	65	14	15	94	15,262	10.04		
Utah	47	6,224,984	32,845	312,760	4,447		41,223	2 40,677	6,665,936	3.00	2,619			1,048	1,078,498	6.18		
Virginia	136	19,116,739	217,455	300,506	156		128,881	2 516,472	20,280,209	2.95	15,221			2,721	4,961,494	4.09		
Washington	39	884,376	83,560	496,875	33,573		14,228	14,932	1,527,544	4.41	1,226	21	416	1,663	280	465,455	3.28	
West Virginia	956	145,993,333	1 6,523,411	2,230,619	364,726	1,966,858	782,329	2 943,033	158,804,309	2.80	86,673	1,963	18,628	107,264	275	29,497,742	5.38	
Wyoming	55	8,669,893	147,044	170,172	5,719		34,059	98,296	9,155,123	2.38	3,447	97	926	4,470	313	1,397,757	6.55	
Grand total	6,620	493,969,171	132,092,503	42,432,667	779,154	7,476,717	2,549,775	2 10,887,082	590,177,069	2.69	326,763	16,643	72,601	416,007	294	109,708,871	5.38	

¹ Includes coal hauled by truck to waterway for shipment by water in following States in 1943: Alabama, 6,492 tons; Illinois, 66,742; Kentucky, 8,300; Ohio 69,219; Pennsylvania, 121,839; Tennessee, 100,696; and West Virginia, 524,138—a grand total of 897,126 tons.

² Includes coal made into beehive coke at mines in following States in 1943: Colorado, 153,762 tons; Kentucky, 34,024; Pennsylvania, 6,879,800; Tennessee, 6,479; Utah, 81,839; Virginia, 496,430; and West Virginia, 663,840—a grand total of 8,185,254 tons.

³ Value received or charged for coal f. o. b. mine, including selling cost. (Includes a value for coal not but used by producer, such as mine fuel and coal coked [not coke] as estimated by producer, at average prices that might have been received if such coal had been sold commercially.)

⁴ As it is necessary to conceal certain items in the lignite break-down of disposition of coal, the figures are shown here in column where greater part of concealed tonnage is included.

TABLE 16.—Number of mines, production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by districts, in 1943

[Districts as defined in Bituminous Coal Act of 1937 and modifications thereto. Exclusive of mines producing less than 1,000 tons]

Minimum price area and producing district	Disposition of coal produced (net tons)										Average number of employees				Number of man-days worked	Average tons per man per day
	Num-ber of active mines	Loaded at mine directly into rail-road cars or river barges	Hauled by truck to railroad siding for shipment by rail and to waterway for shipment by ship-ment by water 1	Shipped by truck or wagon (exclud-ing coal used by mine employ-ees)	Taken by loco-motive tenders at tipple	Shipped by con-veyor or tram to point of sump-tion	Used by mine employ-ees	Used at mines for power and heat and made into beehive coke at mines 1	Total quantity	Aver-age value per ton 1	Surface					
											Under-ground	In strip pits		Total		
												All others	Total			
PRICE AREA 1																
District																
1. Eastern Pennsylv-ania 1	1,214	42,918,095	8,620,801	4,186,636	39,696	2,415,570	200,236	1,864,352	59,245,416	\$2.92	37,921	2,884	7,922	263	12,792,233	4.63
2. Western Penn-sylvania	747	60,734,526	16,464,211	8,802,809	163,520	1,542,715	388,936	16,546,035	84,642,752	2.76	49,114	2,663	8,266	268	16,128,612	5.25
3. Northern West Virginia	360	35,265,307	14,491,128	666,627	146,156	424,205	67,381	1,332,248	41,393,052	2.45	18,483	1,341	4,467	259	6,301,267	6.57
4. Ohio	592	23,520,687	12,530,085	6,026,545	884	38,585	69,906	68,301	32,254,993	2.42	14,206	1,974	4,042	254	6,144,929	6.27
5. Michigan	5	57,141	1,728,944	98,848	187,274	1,073,545	3,113	9,571	5,193,615	4.87	2,751	235	501	257	71,472	2.36
6. Panhandle	43	2,414,654	1,728,944	906,015	187,274	1,073,545	7,352	5,571	5,383,355	2.39	2,751	235	501	261	910,810	5.91
7. Southern num-bered 1	277	61,223,705	744,380	233,304	9,802	142,531	445,012	2,260,052	63,058,486	3.13	41,003	363	8,407	281	13,993,670	4.51
8. Southern num-bered 2	1,146	114,129,977	2,992,551	2,507,642	65,883	676,227	693,821	949,312	122,015,413	2.84	80,170	80	15,388	268	25,596,687	4.77
Total price area 1	4,384	340,264,092	26,572,100	23,488,426	612,915	6,313,378	1,875,757	9,035,414	408,162,082	2.80	243,888	9,570	49,031	268	80,939,680	5.04
PRICE AREA 2																
9. West Kentucky	291	12,997,793	670,081	1,344,977	1,800	31,094	24,785	88,827	15,169,357	1.97	6,680	429	1,733	250	2,211,980	6.86
10. Illinois	349	62,839,698	1,737,267	7,587,677	24,464	235,753	310,125	926,316	72,031,270	2.13	23,473	1,745	7,148	257	8,320,034	8.72
11. Indiana	186	21,196,267	903,884	2,333,763	7,873	463,277	27,553	131,966	25,054,583	2.09	5,907	1,953	2,844	241	2,578,917	9.72
12. Iowa	170	765,952	546,503	1,420,803	-----	-----	26,325	11,027	2,770,610	3.10	2,998	235	492	196	729,468	3.80
Total price area 2	996	97,799,680	2,857,735	12,667,220	34,137	730,124	388,788	1,158,136	115,035,820	2.12	39,058	4,362	12,217	249	13,840,299	8.35

See footnotes at end of table.

TABLE 16.—Number of mines, production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by districts, in 1943—Continued

INDUSTRIES as defined in Bituminous Coal Act of 1937 and modifications thereto. Exclusive of mines producing less than 1,000 tons]

Minimum price area and producing district	Disposition of coal produced (net tons)										Average number of employees				Average number of days mines were active	Number of man-days worked	Average number of man-days worked per day
	Number of active mines	Hauled by truck to railroad siding for shipment by rail and to waterway for shipment by water 1	Loaded at mine directly into railroad cars or river barges	Shipped by truck or wagon (excluding coal used by mine employees)	Taken by locomotive tenders at tipples	Shipped by conveyor or tram to point of shipment	Used by mine employees	Used at mines for power and heat and made into beehive coke at mines 2	Total quantity	Average value per ton 3	Underground	Surface					
												In strip pits	All others	Total			
PRICE AREA 3																	
13. Southeastern.....	370	15,907,921	1,078,629	1,182,547	66,854	283,652	100,246	210,128	18,724,977	\$3.40	21,161	267	4,041	25,469	6,382,126	2.93	
PRICE AREA 4																	
14. Arkansas-Oklahoma.....	99	1,633,178	493,463	76,927			5,279	7,069	2,216,516	4.16	2,938	184	649	3,771	779,664	2.84	
PRICE AREA 5																	
15. Southwestern: Bituminous.....	247	7,998,634	344,925	1,639,668	5,963	35,219	18,113	51,758	10,094,280	2.61	3,413	1,681	1,549	6,643	1,592,424	6.34	
Lignite (Texas).....	3	140,826		(1)	3,318			(1)	144,144	.88	44	14	10	68	8,762	16.45	
Total price area 5.....	250	8,139,460	344,925	1,639,668	9,281	35,219	18,113	51,758	10,238,424	2.58	3,457	1,695	1,559	6,711	1,601,186	6.39	
PRICE AREA 6																	
16. Northern Colorado.....	35	1,625,396	16,044	830,720		30,661	19,106	37,953	2,559,880	2.95	1,671	11	332	2,014	489,078	5.23	
17. Southern Colorado.....	149	5,530,540	336,881	699,356	10,245	27,368	35,021	245,375	6,884,786	3.43	4,974		1,295	6,269	1,715,585	4.01	
18. New Mexico.....	27	551,283	40,685	111,418			3,863	34,375	741,634	3.89	848		350	1,198	333,758	2.22	
Total price areas 6.....	211	7,707,219	393,620	1,641,404	10,245	58,029	57,990	317,703	10,186,300	3.34	7,493	11	1,977	9,481	2,638,421	4.01	

PRODUCTION BY WEEKS AND MONTHS

TABLE 17.—*Bituminous-coal and lignite production (final figures) in the United States in 1943, with estimates by weeks*

Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)	Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)
Jan. 2.....	11,744,000	1	11,896,000	July 17.....	11,733,000	6	1,956,000
Jan. 9.....	11,310,000	6	1,885,000	July 24.....	12,112,000	6	2,019,000
Jan. 16.....	11,760,000	6	1,960,000	July 31.....	12,134,000	6	2,022,000
Jan. 23.....	11,364,000	6	1,894,000	Aug. 7.....	11,921,000	6	1,987,000
Jan. 30.....	11,672,000	6	1,945,000	Aug. 14.....	12,187,000	6	2,031,000
Feb. 6.....	11,947,000	6	1,991,000	Aug. 21.....	12,147,000	6	2,025,000
Feb. 13.....	12,280,000	6	2,047,000	Aug. 28.....	12,276,000	6	2,046,000
Feb. 20.....	12,205,000	6	2,034,000	Sept. 4.....	12,131,000	6	2,022,000
Feb. 27.....	12,726,000	6	2,121,000	Sept. 11.....	11,694,000	5.7	2,052,000
Mar. 6.....	12,276,000	6	2,046,000	Sept. 18.....	12,097,000	6	2,016,000
Mar. 13.....	12,541,000	6	2,090,000	Sept. 25.....	12,227,000	6	2,038,000
Mar. 20.....	12,296,000	6	2,049,000	Oct. 2.....	12,230,000	6	2,038,000
Mar. 27.....	12,619,000	6	2,103,000	Oct. 9.....	12,142,000	6	2,024,000
Apr. 3.....	11,004,000	5.5	2,001,000	Oct. 16.....	11,874,000	6	1,979,000
Apr. 10.....	12,166,000	6	2,028,000	Oct. 23.....	11,515,000	6	1,919,000
Apr. 17.....	11,810,000	6	1,968,000	Oct. 30.....	10,062,000	6	1,677,000
Apr. 24.....	11,638,000	6	1,940,000	Nov. 6.....	3,066,000	6	511,000
May 1.....	9,405,000	6	1,568,000	Nov. 13.....	11,580,000	5.9	1,963,000
May 8.....	9,916,000	6	1,653,000	Nov. 20.....	13,028,000	6	2,171,000
May 15.....	12,090,000	6	2,015,000	Nov. 27.....	12,735,000	5.8	2,196,000
May 22.....	11,426,000	6	1,904,000	Dec. 4.....	13,161,000	6	2,194,000
May 29.....	11,758,000	6	1,960,000	Dec. 11.....	13,564,000	6	2,261,000
June 5.....	3,011,000	5.8	519,000	Dec. 18.....	12,726,000	6	2,121,000
June 12.....	11,703,000	6	1,951,000	Dec. 25.....	9,892,000	5	1,978,000
June 19.....	12,061,000	6	2,010,000	Jan. 1, 1944.....	19,285,000	15	1,845,000
June 26.....	4,626,000	6	771,000				
July 3.....	10,205,000	6	1,701,000		590,177,000	309.4	1,907,000
July 10.....	11,099,000	5.7	1,947,000				

¹ Figures represent output and number of working days in that part of week included in calendar year shown. Total production for week of Jan. 2, 1943, was 9,479,000 tons and for Jan. 1, 1944, was 10,515,000 tons

² Average daily production for entire week and not for working days in calendar year shown.

TABLE 18.—Coal production in the United States, in 1943, by States (final figures), with estimates by months, in thousands of net tons

(Totals for year are based on final complete returns from all operators known to have produced more than 1,000 tons a year. The apportionment of known yearly total among the twelve months is based upon best information available; in some States upon direct tonnage reports by operators to State mine departments; in most cases upon current records of railway carloadings and waterway shipments.)

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama.....	1,638	1,470	1,626	1,332	1,562	893	1,637	1,600	1,551	950	1,383	1,619	17,160
Alaska.....	27	25	26	22	24	20	19	19	21	26	29	31	280
Arkansas.....	165	165	180	122	95	402	152	144	150	152	129	144	1,718
Colorado.....	796	739	819	598	655	414	647	674	705	750	641	886	8,324
Georgia.....	1	1	2	1	1	1	1	1	1	1	1	2	14
Illinois.....	6,900	5,973	7,046	6,203	5,155	4,397	6,436	6,465	6,504	6,052	5,580	7,020	72,631
Indiana.....	2,150	2,075	2,335	2,240	1,772	1,540	2,210	2,280	2,390	1,673	1,980	2,430	25,065
Iowa.....	296	279	304	252	208	168	179	182	214	211	1,000	258	2,771
Kansas.....	305	335	334	290	229	229	274	259	256	305	302	319	3,437
Kentucky:													
Eastern.....	3,884	4,028	4,599	3,971	4,062	2,744	4,501	4,247	4,287	3,880	3,555	4,264	48,042
Western.....	1,284	1,270	1,422	1,260	1,195	962	1,270	1,342	1,309	1,273	1,234	1,348	15,169
Total Kentucky.....	5,168	5,298	6,021	5,231	5,257	3,706	5,771	5,589	5,596	5,153	4,789	5,612	63,211
Maryland.....	138	162	198	180	160	133	179	174	165	153	134	157	1,933
Michigan.....	17	19	20	11	12	10	14	14	13	13	12	14	169
Missouri.....	382	420	419	364	287	287	344	325	321	382	379	400	4,310
Montana:													
Bituminous.....	429	390	393	363	359	306	396	398	403	422	481	459	4,769
Lignite.....	6	5	5	5	5	4	5	5	5	6	7	6	64
Total Montana.....	435	395	398	368	364	310	401	373	408	428	488	465	4,833
New Mexico.....	159	158	180	160	138	108	173	161	155	157	137	165	1,851
North Dakota (lignite).....	205	200	204	112	111	117	149	133	184	270	324	331	2,500
Ohio.....	2,623	2,628	3,103	2,801	2,850	1,941	2,939	2,808	2,874	2,840	2,236	2,712	25,255
Oklahoma.....	272	273	296	201	157	170	231	238	247	252	213	268	2,838
Pennsylvania (bituminous).....	11,228	11,634	13,268	11,375	11,672	7,737	12,367	12,989	12,818	12,698	10,330	12,934	141,050
South Dakota (lignite).....	5	5	5	2	4	4	2	2	2	3	3	4	41
Tennessee.....	634	624	720	610	576	390	598	596	603	570	572	686	7,179
Texas:													
Bituminous.....	1	1	1	(*)	(*)	(*)	1	1	1	1	1	1	9
Lignite.....	20	13	10	8	9	7	9	8	12	15	15	18	144
Total Texas.....	21	14	11	9	9	7	10	9	13	16	16	19	153

See footnotes at end of table.

TABLE 18.—*Coal production in the United States, in 1943, by States (final figures), with estimates by months, in thousands of net tons—Con.*

[Totals for year are based on final complete returns from all operators known to have produced more than 1,000 tons a year. The apportionment of known yearly total among the twelve months is based upon best information available; in some States upon direct tonnage reports by operators to State mine departments; in most cases upon current records of railway carloadings and waterway shipments.]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Utah.....	550	528	610	570	563	353	568	550	557	589	565	663	6,666
Virginia.....	1,664	1,727	1,920	1,732	1,700	1,251	1,908	1,782	1,768	1,602	1,476	1,745	20,280
Washington.....	141	147	155	129	130	92	130	125	126	123	90	140	1,528
West Virginia.....	12,257	12,963	15,123	13,521	12,975	9,665	14,217	14,377	13,922	13,301	12,069	14,314	168,804
Wyoming.....	872	810	879	754	703	494	729	711	782	839	714	868	9,155
Other States ¹	1	1	1	1	1	1	1	1	1	1	1	1	12
Total bituminous and lignite.....	47,850	49,158	56,203	49,190	47,390	34,540	52,306	52,586	52,407	49,510	44,812	54,225	590,177
Pennsylvania anthracite ²	4,466	5,203	5,855	337	5,219	3,244	6,668	3,633	5,474	6,359	4,140	4,996	60,644
Grand total.....	52,316	54,361	62,058	54,527	52,609	37,784	58,974	56,219	57,881	54,869	48,952	59,221	650,821

¹ Includes Arizona and Oregon.

² Includes Sullivan County, washery and dredge coal, local sales, colliery fuel, and coal shipped by truck from authorized operations; also includes some "bootleg" coal purchased by legitimate operators and prepared at their breakers.

³ Less than 500 tons.

TABLE 19.—*Number and production of bituminous-coal and lignite mines in the United States, classified by size of output in each State, in 1943.*
 [Exclusive of mines producing less than 1,000 tons]

State	Class 1A, more than 500,000 tons						Class 1B, 200,000 to 500,000 tons						Class 2, 100,000 to 200,000 tons					
	Mines			Production			Mines			Production			Mines			Production		
	Num- ber	Per- cent	Total (net tons)	Average per mine (net tons)	Per- cent		Num- ber	Per- cent	Total (net tons)	Average per mine (net tons)	Per- cent		Num- ber	Per- cent	Total (net tons)	Average per mine (net tons)	Per- cent	
Alabama	6	2.1	4,151,955	691,993	24.2		27	9.5	7,406,299	274,307	43.2		23	8.0	2,984,471	129,760	17.4	
Alaska													1	20.0	113,253	113,253	39.1	
Arizona																		
Arkansas																		
California	1	.6	649,148	649,148	7.8		9	5.1	2,265,077	251,675	27.2		3	4.5	392,169	130,720	22.8	
Colorado													19	10.8	2,835,384	149,231	34.1	
Illinois	57	16.3	57,435,812	1,007,646	79.1		25	7.2	7,684,800	307,392	10.6		17	4.9	2,330,224	137,072	3.2	
Indiana	16	8.6	13,383,757	836,485	53.4		21	11.3	7,216,617	343,648	28.8		14	7.5	2,073,606	148,115	8.3	
Iowa							1	.6	202,946	202,946	7.3		3	1.8	393,610	131,203	14.2	
Kansas							6	8.7	2,247,616	374,603	65.4		3	4.4	506,338	168,786	14.7	
Kentucky							84	8.8	24,638,057	293,286	39.0		66	6.9	9,653,338	146,263	15.3	
Maryland	21	2.2	19,247,221	916,534	30.4		2	2.0	515,791	257,896	26.7		1	1.0	118,186	118,186	6.1	
Michigan													1	20.0	114,199	114,199	67.7	
Missouri	1	.8	695,204	695,204	16.1		5	3.9	1,763,590	352,718	40.9		4	3.1	606,529	151,632	14.1	
Montana (bituminous)	2	5.7	3,093,340	1,546,670	64.9		3	8.6	1,037,298	345,756	21.7		2	5.7	354,110	177,055	7.4	
Montana, North Dakota, South Dakota, and Texas (lignite)																		
New Mexico							6	4.6	2,000,507	333,418	72.8		1	.8	126,904	126,904	4.6	
Ohio	15	2.5	14,245,767	949,718	44.2		4	12.5	1,217,187	304,297	65.8		2	6.3	317,618	158,809	17.2	
Oklahoma							23	3.9	7,459,816	324,340	23.1		23	3.9	3,449,331	149,971	10.7	
Oregon							3	3.7	1,000,883	333,628	35.3		5	6.1	716,224	143,245	25.2	
Pennsylvania	72	3.9	67,650,825	939,595	48.0		100	5.5	31,670,910	316,709	22.4		110	6.0	15,079,515	137,087	10.7	
Tennessee	1	.6	536,322	536,322	7.5		13	7.2	3,300,597	253,892	46.0		10	5.6	1,323,621	132,362	18.4	
Texas (bituminous)																		
Utah	4	8.5	3,294,048	823,512	49.4		7	14.9	2,388,860	341,266	35.8		3	6.4	373,193	124,398	5.6	
Virginia	12	8.8	9,815,725	817,977	48.4		20	14.7	6,454,610	322,731	31.8		18	13.2	2,631,856	146,214	13.0	
Washington							1	2.6	226,552	226,552	14.8		5	12.8	742,738	148,548	48.6	
West Virginia	103	10.8	78,027,467	757,548	49.1		172	18.0	52,373,982	304,500	33.0		122	12.8	16,913,694	138,637	10.6	
Wyoming	7	12.7	6,075,738	867,963	66.3		5	9.1	1,425,415	285,083	15.6		8	14.5	1,163,121	145,390	12.7	
Total	318	4.8	278,302,329	875,165	47.1		537	8.1	164,495,380	306,323	27.9		404	7.0	65,313,242	140,701	11.1	

TABLE 19.—Number and production of bituminous-coal and lignite mines in the United States, classified by size of output in each State, in 1943—Continued

[Exclusive of mines producing less than 1,000 tons]

State	Class 3, 50,000 to 100,000 tons				Class 4, 10,000 to 50,000 tons				Class 5, less than 10,000 tons				Total	
	Mines		Production		Mines		Production		Mines		Production		Mines	Production (net tons)
	Num-ber	Per-cent	Total (net tons)	Aver-age per mine (net tons)	Num-ber	Per-cent	Total (net tons)	Aver-age per mine (net tons)	Num-ber	Per-cent	Total (net tons)	Aver-age per mine (net tons)		
Alabama	16	5.6	1,163,352	72,710	43	15.0	902,543	20,989	171	59.8	551,700	3,226	286	17,160,320
Alaska	2	40.0	162,755	81,378	—	—	—	—	2	40.0	13,224	6,612	5	280,232
Arizona	—	—	—	—	—	—	—	—	3	100.0	11,281	3,760	3	11,281
Arkansas	9	13.6	605,758	67,306	23	34.9	503,805	25,818	31	47.0	126,213	4,071	66	1,717,935
Colorado	18	10.2	1,281,840	71,213	40	22.7	933,636	23,341	89	50.6	359,107	4,035	176	8,324,192
Georgia	—	—	—	—	—	—	—	—	—	—	—	—	1	14,385
Illinois	25	7.2	1,906,049	76,242	108	100.0	14,385	14,385	117	33.5	506,507	4,329	349	72,631,370
Indiana	16	8.6	1,137,703	71,112	39	30.9	2,767,878	25,629	3.8	80	288,054	3,601	186	25,064,583
Iowa	10	5.9	732,300	73,236	47	27.6	964,756	24,737	3.8	80	441,131	4,047	170	2,770,610
Kansas	2	2.9	122,044	61,022	19	27.5	1,000,563	21,289	36.1	109	64.1	4.0	69	3,436,781
Kentucky	63	6.6	4,553,963	72,285	159	16.7	3,890,372	20,012	11.1	39	56.5	180,526	955	63,211,473
Maryland	10	10.0	640,802	64,080	20	20.0	3,287,372	20,675	5.2	562	1,833,522	3,262	100	1,933,380
Michigan	—	—	—	—	30	60.0	452,233	22,612	23.4	67	206,368	3,050	100	1,933,380
Missouri	3	2.3	198,097	66,032	3	25.0	49,964	16,655	2.0	20	4.52	4.452	128	4,309,636
Montana (bituminous)	2	5.7	115,051	57,526	52	14.3	745,894	23,309	17.3	83	300,322	3,618	35	4,768,660
Montana, North Dakota, and South Dakota	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Texas (bituminous)	2	1.5	137,268	68,633	14	10.7	280,588	20,042	10.2	108	204,128	1,890	131	2,749,393
New Mexico	1	3.1	57,069	57,069	9	28.1	204,043	22,671	11.0	16	54,890	3,431	32	1,850,827
Ohio	33	5.6	2,314,224	70,128	151	25.5	3,368,161	22,433	10.5	347	1,397,694	4,028	862	32,254,933
Oklahoma	7	8.5	482,589	68,941	21	25.6	447,420	21,306	15.8	46	190,231	4,135	82	2,837,437
Oregon	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pennsylvania	145	7.9	10,158,008	70,055	541	29.5	12,830,445	23,727	9.1	866	3,654,111	4,220	1,834	41,046,814
Tennessee	17	9.4	1,196,444	69,791	29	16.1	467,875	16,134	6.5	110	61.1	364,059	180	7,178,018
Texas (lignite)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Utah	4	8.5	292,695	73,174	11	23.4	265,645	24,160	4.0	18	33.3	61,495	1	9,097
Virginia	10	7.4	737,036	73,704	18	13.2	401,636	22,313	4.0	18	28.9	3,486	47	6,665,630
Washington	4	10.2	262,091	65,523	12	30.8	230,816	19,235	16.2	58	339,346	4,127	136	20,290,200
West Virginia	79	8.3	5,839,083	73,912	187	19.5	4,644,232	24,301	2.9	17	65,347	3,844	39	1,527,544
Wyoming	3	5.5	217,919	72,640	12	21.8	220,572	18,381	2.4	20	30.6	1,105,851	966	188,904,309
Total	481	7.3	34,304,308	71,319	1,544	23.3	35,494,571	22,982	6.0	3,276	49,612,277	3,748	6,620	360,177,069

AVERAGE VALUE

Before the Bituminous Coal Act of 1937 was passed, the most valuable single index of the trend of prices at the mines was the "average value per ton, f. o. b. mines," as given in the familiar annual coal reports of the Bureau of Mines, United States Department of the Interior. This series was referred to in Bureau of Mines reports as representing "bituminous coal," and it covered all coal (other than Pennsylvania anthracite) produced in the United States. It represented the bituminous-coal industry as the term ordinarily was used in the trade and included the lignite of the Dakotas, Texas, and Montana, as well as any small tonnages of hard coal produced outside of Pennsylvania.

With the passage of the Coal Act, the Bureau of Mines relinquished the collection of statistics relating to bituminous coal, effective June 30, 1937, though continuing to compile data regarding lignite and Pennsylvania anthracite. Effective the same date, the Coal Commission became responsible for the compilation of data on bituminous coal, though not attempting to collect data regarding lignite, which was specifically exempted by the Act. The records of the Commission (later the Bituminous Coal Division, United States Department of the Interior) relate to all coal other than Pennsylvania anthracite, Virginia semianthracite, and lignite.

To permit comparison of the old and new series, therefore, it is necessary to separate the lignites from the bituminous coals, though the combined average for the two is continued in a form as nearly comparable as possible with the old series. (See table 20).

A more important change in the two series relates to the treatment of selling expenses. The old Bureau of Mines series of "value at the mines" excluded the selling cost. Reporting operators were asked to state the "Amount received at the mines f. o. b. cars less the selling expense." No details were asked regarding the items included in the value, and no systematic effort was made to follow up the exclusion of selling expenses. It was realized at the time that some producers might find it impractical to exclude selling costs and that some part of the selling expenses of the industry might be included in the results. Nevertheless, the reports were checked for consistency from year to year, the questions were retained in the same form without change, and the results are believed to have been comparable from one year to the next. The new series of the Coal Commission represents the total or gross realization on all coal produced and specifically includes the selling cost.

The two sets of data may not be precisely comparable with respect to coal produced but not sold on the commercial market. In the Bureau of Mines series reporting operators were instructed that the "value of coal not sold but used by producer, also mine fuel and coal made into coke, should be estimated at average prices that might have been received." The instructions of the Coal Commission regarding such items were in effect similar, though given in greater detail.

A comparison of the two series is possible for 1936. In that year the average value per ton on the old (Bureau of Mines) basis amounted to \$1.761 per ton for bituminous coal, excluding lignite. The average gross realization, according to data collected by the Coal Commission,

was \$1.831 per ton. The difference amounts to \$0.07 per ton—an amount somewhat less than the average selling expenditure computed per ton of all coal produced, as reported to the Coal Commission. The comparison confirms previous indications that the great majority of operators reporting in earlier years had followed instructions and omitted selling expenses in computing the average value but that some of them had included the selling expense. The change in method of reporting should be kept in mind in comparing the two sets of data. As the reports to the Commission were submitted on a detailed accounting return and made under oath, they are to be accepted. The returns of earlier years, upon a voluntary basis and not in all instances uniform as to treatment of selling costs, seem to have been thoroughly comparable from one year to the next and afford the best available index to the rise and fall of the mine prices received by operators down to 1936.

TABLE 20.—Trend of average value in the United States of bituminous coal and lignite per ton, f. o. b. mines, 1929–43

Year	Bituminous coal (subject to regulation under 1937 Act) ¹	Lignite ²	Total
Average value per ton less selling cost:			
1929.....	\$1.782	\$1.548	\$1.781
1930.....	1.702	1.556	1.701
1931.....	1.542	1.410	1.541
1932.....	1.313	1.313	1.313
1933.....	1.337	1.188	1.336
1934.....	1.751	1.387	1.749
1935.....	1.772	1.120	1.767
1936.....	1.761	1.061	1.756
Average gross realization, selling cost not deducted:			
1936.....	1.831	³ 1.061	1.826
1937.....	1.946	³ 1.080	1.939
1938.....	1.955	³ 1.071	1.947
1939 ⁴	1.850	1.158	1.845
1940.....	1.913	³ 1.156	1.908
1941.....	2.194	1.237	2.189
1942.....	2.363	1.364	2.358
1943.....	2.691	1.490	2.685

¹ Includes all coal produced other than Pennsylvania anthracite and the lignite included in the second column.

² North Dakota, South Dakota, and the lignite counties of Montana and Texas.

³ Figures for 1936–38 and 1940 exclude selling cost as before.

⁴ Producers were asked to exclude selling cost in reporting value, but a number of them included such costs.

LABOR STATISTICS

Men employed.—An average of 416,007 men was employed at bituminous-coal mines in 1943, a 10.0-percent decrease from the total of 461,991 for 1942. (See fig. 10.)

The method used here in calculating employment gives an accurate measure of the working force in the coal industry, but it does not consider the time lost by men on the rolls through intermittent operations. To measure the influence of intermittency upon employment, the factor of mine activity as indicated by the average number of days of plant operation was recorded separately. The average number of men employed when the mines were in operation was then used, in conjunction with the average number of days of operation, as a measure of the total volume of employment in the industry.

Days operated.—The average number of days of operation at bituminous-coal mines in 1943 was 264. This represents an increase over the average of 246 days for 1942. All statistics on days of mine operation included in this report are weighted averages, in which the operating time of each mine has been weighted by the number of its employees. Several coal-mining States publish series on the number of days worked that are simple averages of the figures for each reporting mine, regardless of size. As these unweighted averages are likely to be unduly depressed by small mines, which generally operate fewer days than the larger ones, they tend to understate the working time of a typical mine employee.

Man-days of labor.—Only a small proportion of the bituminous-coal-mine operations, however, keep an accurate record of man-days or man-hours worked. Consequently, man-days have been computed by multiplying the number of workers employed by the number of operating days. Although these computations were made for each individual mine, the combined total is necessarily only an approximation.

Until the American coal industry arranges to keep an accurate record of man-days or man-hours of employment, all computations of accident rates, daily earnings, and output per man will remain subject to qualification. Meanwhile, the method of multiplying men by days must be accepted as the best available procedure.

Data for 1943 indicate that bituminous-coal-mine employees performed 109,708,871 man-days of labor during the year. Table 15 gives a summary record of men employed, days operated, and output per man per day at bituminous-coal mines, by States, in 1943. Details by counties for 1943 are shown in table 41.

Length of working day.—Table 21 summarizes the replies of mine operators to the question, "Number of hours operated per shift."

The established working day does not of itself measure the length of time that men actually work or the time that they are underground, because of the possibility of overtime, because the mine may sometimes shut down before the full day is over, because the miner may go home before the mine stops, and because he spends considerable time going to and from his place of work underground. These figures represent the operator's statement of the nominal operating day for the mine. They do not purport to represent the time actually worked by the men. On the one hand, they make no allowance for tonnage of piece workers who leave early; on the other hand, they make no allowance for tonnage men who continue at work after the mine as a whole is shut down or who go into the mine to work on days when the tippie is idle.

It was found that 73.8 percent of the men employed were in 7-hour mines and that the weighted average working shift was 7.23 hours.

TABLE 21.—*Number of bituminous-coal and lignite mines in the United States having established working shift of certain length and number of men employed therein in 1943*

State	7 hours		8 hours		9 hours		All others ¹		Total	
	Mines	Men	Mines	Men	Mines	Men	Mines	Men	Mines	Men
Alabama.....	112	8, 104	169	14, 609	3	539	2	22	286	23, 274
Alaska.....	2	156	3	95					5	251
Arizona.....			3	31					3	31
Arkansas.....	40	1, 565	22	1, 124	2	109	2	32	66	2, 830
Colorado.....	129	6, 299	39	873			8	275	176	7, 447
Georgia.....			1	60					1	60
Illinois.....	256	27, 258	68	2, 237			25	2, 871	349	32, 366
Indiana.....	83	6, 073	64	1, 488	1	15	38	3, 128	186	10, 704
Iowa.....	81	1, 908	67	1, 394	6	147	16	286	170	3, 725
Kansas.....	11	370	46	917			12	719	69	2, 006
Kentucky:										
Eastern.....	453	33, 779	200	7, 566	2	20	9	1, 741	664	43, 106
Western.....	247	6, 693	40	2, 079	2	59	2	11	291	8, 842
Total Kentucky.....	700	40, 472	240	9, 645	4	79	11	1, 752	955	51, 948
Maryland.....	67	1, 460	32	599			1	11	100	2, 070
Michigan.....	4	123	1	155					5	278
Missouri.....	24	749	86	1, 567	5	43	13	593	128	2, 952
Montana:										
Bituminous.....	23	1, 099	12	196					35	1, 295
Lignite.....	2	5	8	42			5	19	15	66
Total Montana.....	25	1, 104	20	238			5	19	50	1, 361
New Mexico.....	12	1, 153	20	850					32	2, 003
North Dakota (lignite).....	8	84	55	574	8	39	35	305	106	1, 002
Ohio.....	294	15, 380	248	3, 469	4	64	56	1, 309	592	20, 222
Oklahoma.....	55	1, 577	22	876	2	39	3	108	82	2, 600
Oregon.....			1	6					1	6
Pennsylvania.....	1, 220	83, 008	454	17, 286	24	346	136	4, 576	1, 834	105, 816
South Dakota (lignite).....	1	1	2	22	2	4	2	2	7	29
Tennessee.....	118	5, 964	55	1, 612	2	109	5	241	180	7, 926
Texas:										
Bituminous.....			1	26					1	26
Lignite.....				21			2	47	3	68
Total Texas.....			2	47			2	47	4	94
Utah.....	26	2, 322	20	1, 118			1	227	47	3, 667
Virginia.....	75	11, 145	58	6, 670	2	16	1	111	136	17, 942
Washington.....	35	1, 471	4	192					39	1, 663
West Virginia.....	691	84, 696	211	18, 886	6	218	48	3, 464	956	107, 284
Wyoming.....	32	3, 859	20	550	1	22	2	39	55	4, 470
Grand total.....	4, 091	306, 901	2, 033	87, 180	72	1, 789	424	20, 137	6, 620	416, 007

¹ Includes mines where day was more than 9 or less than 7 hours or was irregular.

BITUMINOUS COAL AND LIGNITE LOADED FOR SHIPMENT BY INDIVIDUAL RAILROADS AND WATERWAYS

TABLE 22.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in 1943*¹

Route	State	Net tons	
		By State	Total for route
RAILROADS			
Alabama Central	Alabama	144,813	144,813
Alabama Great Southern	do	217,288	217,288
Alaska	Alaska	268,543	268,543
Alpers, Winslow & Western	Indiana	2,649,306	2,649,306
Alton	Illinois	885,275	885,275
Aramus-Jellico	Kentucky	485,483	485,483
	Colorado	407,884	
	Illinois	717,914	
Atchison, Topeka & Santa Fe	Kansas	435,254	2,927,851
	Missouri	3,077	
	New Mexico	1,363,722	
	Illinois	470,621	
	Indiana	752,744	
	Maryland	38,653	
Baltimore & Ohio	Ohio	4,311,050	43,587,903
	Pennsylvania	13,311,357	
	West Virginia	24,703,478	
Bessemer & Lake Erie	Pennsylvania	3,754,710	3,754,710
Bever & Southern	Missouri	686,502	686,502
Brimstone	Tennessee	30,556	30,556
Buffalo Creek & Gauley	West Virginia	759,222	759,222
Cambria & Indiana	Pennsylvania	4,749,075	4,749,075
Campbell's Creek	West Virginia	920,695	920,695
Carbon County	Utah	1,063,223	1,063,223
Caseyville	Illinois	202,590	202,590
Central of Georgia	Alabama	851,541	865,173
	Georgia	13,632	
	Kentucky	11,491,800	
Chesapeake & Ohio	Ohio	743,437	63,449,168
	West Virginia	51,213,931	
Cheswick & Harmar	Pennsylvania	1,000,491	1,000,491
Chicago, Attica & Southern	Indiana	5,220	5,220
	Colorado	437,442	
Chicago, Burlington, & Quincy	Illinois	11,353,909	13,411,181
	Iowa	360,175	
	Missouri	60,042	
	Wyoming	1,199,613	
Chicago & Eastern Illinois	Illinois	2,716,226	4,610,411
	Indiana	1,894,185	
Chicago & Illinois Midland	Illinois	5,310,502	5,310,502
Chicago, Indianapolis, & Louisville	Indiana	1,412,912	1,412,912
	do	6,144,416	
	Iowa	379,205	
	Missouri	9,478	
Chicago, Milwaukee, St. Paul, & Pacific	Montana (bituminous)	1,079,842	7,677,743
	North Dakota (lignite)		
	South Dakota (lignite)	63,524	
	Washington	1,278	
Chicago & North Western	Illinois	3,321,614	3,321,614
	Arkansas	30,364	
Chicago, Rock Island, & Pacific	Illinois	568,906	1,094,134
	Iowa	123,592	
	Missouri	286,190	
	Oklahoma	85,082	
Cleveland, Cincinnati, Chicago & St. Louis	Illinois	5,317,959	8,330,313
	Indiana	3,012,354	
	Kentucky	28,339	
Clinchfield	Virginia	3,073,953	3,102,292
Colorado & Southeastern	Colorado	195,703	
Colorado & Southern	do	722,775	722,775
Colorado & Wyoming	do	645,898	645,898
Conemaugh & Black Lick	Pennsylvania	25,086	25,086
Cumberland & Pennsylvania	Maryland	573,533	575,869
	West Virginia	2,366	
Denver & Intermountain	Colorado	122,009	122,009
	Colorado	1,775,265	
Denver & Rio Grande Western	New Mexico	18,888	5,464,270
	Utah	3,670,117	
Denver & Salt Lake	Colorado	1,173,727	1,173,727
Des Moines & Central Iowa	Iowa	33,413	33,413
Detroit, Toledo, & Ironton	Ohio	13,241	13,241

See footnotes at end of table.

TABLE 22.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in 1943*—Con.

Route	State	Net tons	
		By State	Total for route
RAILROADS—continued			
East Broad Top Railroad & Coal Co	Pennsylvania	487,698	487,698
Erie	Ohio	90,213	
Evansville & Ohio Valley	Pennsylvania	1,103,815	1,194,028
Evansville, Suburban, & Newburgh	Indiana	19,687	
Fort Dodge, Des Moines & Southern	do	248,177	248,177
Fort Smith, Subiaco, & Rock Island	Iowa	33,729	
Fort Smith & Van Buren	Arkansas	15,728	15,728
Fort Smith & Western	Oklahoma	170,236	
Galesburg & Great Eastern	do	5,738	5,738
	Illinois	686,736	
Great Northern	Montana (bituminous)	447,001	568,906
	North Dakota (lignite)	(?)	
Gulf, Mobile, & Ohio	Washington	121,905	1,692,838
	Alabama	274,764	
Harriman & Northeastern	Illinois	1,418,074	73,211
Huntingdon & Broad Top Mountain Railroad & Coal Co	Tennessee	73,211	
Illinois Central	Pennsylvania	270,963	270,963
	Alabama	267,661	
	Illinois	14,406,637	22,395,325
	Indiana	112,018	
	Kentucky	7,609,009	
Illinois Terminal	Illinois	418,795	
Interstate	Kentucky	108,461	418,795
	Virginia	2,766,547	
Iowa Southern Utilities Co	Iowa	156,253	2,875,008
Johnstown & Stony Creek	Pennsylvania	248,337	
Joplin-Pittsburg	Kansas	435,065	435,065
Kanawha Central	West Virginia	115,376	
	Kansas	475,307	541,029
Kansas City Southern	Missouri	20,051	
	Oklahoma	45,671	15,320
Kansas, Oklahoma, & Gulf	Oklahoma	15,320	
Kelley's Creek & Northwestern	West Virginia	1,931,150	1,931,150
Kentucky & Tennessee	Kentucky	894,520	
Lake Erie, Franklin, & Clarion	Pennsylvania	632,519	632,519
Laramie, North Park, & Western	Colorado	6,777	
Ligonier Valley	Pennsylvania	134,042	134,042
Litchfield & Madison	Illinois	805,760	
	Alabama	2,979,283	35,471,579
	Illinois	1,717	
Louisville & Nashville	Kentucky	31,003,988	
	Tennessee	1,090,237	
	Virginia	396,354	859,947
Mary Lee	Alabama	859,947	
Midland Valley	Arkansas	534,023	816,391
	Oklahoma	282,368	
Minneapolis & St. Louis	Illinois	2,143,162	2,333,198
	Iowa	90,036	
Minneapolis, St. Paul, & Sault Ste. Marie	North Dakota (lignite)	1,247,798	1,247,798
Missouri-Illinois	Illinois	41,378	
	Kansas	299,829	1,120,744
Missouri-Kansas, Texas	Missouri	192,245	
	Oklahoma	487,844	
	Texas (lignite)	140,826	
	Arkansas	908,971	10,137,171
Missouri Pacific	Illinois	7,064,015	
	Kansas	830,383	
	Missouri	1,062,233	
	Oklahoma	271,569	11,727
Monessen Southwestern	Pennsylvania	11,727	
Monongahela	do	2,102,675	13,780,041
	West Virginia	11,677,366	
Montana, Wyoming, & Southern	Montana (bituminous)	499,748	499,748
Montour	Pennsylvania	6,402,499	
	Alabama	3,222	1,130,125
Nashville, Chattanooga, & St. Louis	Tennessee	1,126,903	
New York Central (Includes coal shipped over Kanawha & Michigan, Kelley's Creek, Toledo & Ohio Central, and Zanesville & Western)	Ohio	6,447,008	13,384,826
	Pennsylvania	5,752,965	
	West Virginia	1,184,853	2,468,426
Nicholas, Fayette, & Greenbrier	do	2,468,426	
	Kentucky	5,996,685	52,107,435
Norfolk & Western	Virginia	11,496,927	
	West Virginia	34,613,823	

See footnotes at end of table.

TABLE 22.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in 1943*—Con.

Route	State	Net tons	
		By State	Total for route
RAILROADS—continued			
Northern Pacific.....	Montana (bituminous).....	2,572,575	3,881,179
	North Dakota (lignite).....	607,899	
	Washington.....	700,705	
Oklahoma City-Ada-Atoka.....	Oklahoma.....	33,738	33,738
Oneida & Western.....	Tennessee.....	35,842	35,842
Pacific Coast.....	Washington.....	107,687	107,687
	Illinois.....	277,886	54,152,644
	Indiana.....	4,037,232	
	Ohio.....	6,481,524	
	Pennsylvania.....	42,420,363	
	West Virginia.....	935,639	
Pennsylvania (includes Pittsburgh, Cincinnati, Chicago, & St. Louis).....	Illinois.....	320,800	320,800
Peoria Terminal.....	Michigan.....	57,141	57,141
Pere Marquette.....	Oklahoma.....	8,008	8,008
Pittsburg County.....	Pennsylvania.....	3,343,210	3,343,210
Pittsburg & Lake Erie.....	do.....	2,253,636	2,253,636
Pittsburg & Shawmut.....	do.....	529,567	529,567
Pittsburg, Shawmut, & Northern.....	do.....	4,874	4,874
Pittsburgh, Chartiers, & Youghiogheny.....	Ohio.....	27,153	29,291
Pittsburgh, Lisbon, & Western.....	Pennsylvania.....	2,138	
	Ohio.....	929,232	
Pittsburgh & West Virginia.....	Pennsylvania.....	1,155,270	2,363,529
	West Virginia.....	279,027	
	do.....	123,721	123,721
Preston.....	Colorado.....	12,263	12,263
Rio Grande Southern.....	Texas (lignite).....	(¹)	(¹)
Rockdale, Sandow, & Southern.....	Illinois.....	317,998	317,998
St. Louis & O'Fallon.....	Alabama.....	1,919,504	4,253,546
	Arkansas.....	148,310	
	Kansas.....	580,767	
	Missouri.....	367,223	
	Oklahoma.....	1,237,742	
St. Louis Southwestern of Texas.....	Texas (lignite).....	(¹)	(¹)
Seaboard Air Lines.....	Alabama.....	78,520	78,520
	do.....	3,395,400	10,765,967
	Illinois.....	26,510	
	Indiana.....	1,811,900	
	Kentucky.....	1,371,031	
	Tennessee.....	2,749,393	
Southern.....	Virginia.....	1,411,753	311,073
	New Mexico.....	311,023	
	Oregon.....	50	
Southern Pacific.....	Illinois.....	420,320	420,320
Springfield & Southwestern.....	do.....	726,932	726,932
Springfield Terminal.....	Tennessee.....	1,028,131	1,028,131
Tennessee.....	do.....	424,234	424,234
Tennessee Central.....	Alabama.....	2,926,055	2,926,055
Tennessee Coal, Iron, & Railroad Co.....	Texas (bituminous).....	7,562	7,562
Texas & Pacific.....	Alabama.....	599,225	599,225
Thomas & Sayreton.....	Illinois.....	105,274	105,274
Toledo, Peoria, & Western.....	Pennsylvania.....	218,918	218,918
Union.....	Colorado.....	907,463	8,617,692
	Utah.....	26,574	
	Washington.....	36,361	
Union Pacific.....	Wyoming.....	7,647,294	854,508
Unity.....	Pennsylvania.....	854,508	
Utah.....	Utah.....	1,497,915	1,497,915
Virginian.....	Virginia.....	188,660	13,649,742
	West Virginia.....	13,461,082	
	Illinois.....	3,079,564	
Wabash.....	Iowa.....	136,052	3,653,876
	Missouri.....	438,260	
	West Virginia.....	551,479	551,479
West Virginia Northern.....	Pennsylvania.....	181,586	181,586
Western Allegheny.....	Maryland.....	958,782	5,791,691
	Pennsylvania.....	470,905	
	West Virginia.....	4,362,004	
Western Maryland.....	Ohio.....	5,751,412	5,751,412
Wheeling & Lake Erie.....	West Virginia.....	210,436	210,436
Winifrede.....	Alabama.....	911,341	911,341
Woodward Iron Co.....	Ohio.....	68,784	68,784
Youngstown & Suburban.....			
Total railroad shipments.....		495,863,581	495,863,581

See footnotes at end of table.

TABLE 22.—*Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in 1943*¹—Con.

Route	State	Net tons	
		By State	Total for route
WATERWAYS			
Allegheny River.....	Pennsylvania.....	1, 236, 845	1, 236, 845
Black Warrior River.....	Alabama.....	262, 984	262, 984
Cheat River.....	Pennsylvania.....	14, 921	14, 921
Illinois River.....	Illinois.....	449, 861	449, 861
Kanawha River.....	West Virginia.....	1, 709, 032	1, 709, 032
Kentucky River.....	Kentucky.....	8, 300	8, 300
Monongahela River.....	Pennsylvania.....	23, 705, 015	24, 665, 371
Muskingum River.....	West Virginia.....	960, 356	
Ohio River.....	Ohio.....	1, 184, 329	1, 184, 329
	Kentucky.....	212, 627	
	Ohio.....	3, 389	549, 298
	West Virginia.....	333, 282	
Tennessee River.....	Tennessee.....	100, 696	100, 696
Youghiogheny River.....	Pennsylvania.....	6, 456	6, 456
Total waterway shipments.....		30, 188, 093	30, 188, 093
Total loaded at mines for shipment by railroads and waterways.....		526, 051, 674	526, 051, 674
Shipped by truck or wagon.....		42, 432, 667	42, 432, 667
Taken by locomotive tenders at tipple.....		779, 154	779, 154
Shipped by conveyor or tram to point of consumption.....		7, 476, 717	7, 476, 717
Coal used by employees.....		2, 549, 775	2, 549, 775
Used at mine for power and heat.....		2, 701, 828	2, 701, 828
Made into beehive coke at mine.....		8, 185, 254	8, 185, 254
Total production.....		590, 177, 069	590, 177, 069

¹ Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding for shipment by rail, and hauled by truck to waterway for shipment by water. In general, figures show quantity of bituminous coal and lignite originated for each railroad and waterway as reported by mine operators. It must be noted that in one year an operator may report coal loaded on subsidiary railroad and in another year same operator may report coal loaded on parent railroad system.

² Tonnage from North Dakota lignite mines shipping on Great Northern Railway included with that shipped on Minneapolis, St. Paul, & Sault Ste. Marie Railway.

³ Tonnage from Texas lignite mines shipping on Rockdale, Sandow, & Southern Railroad and St. Louis Southwestern Railway Co. of Texas included with that shipped on Missouri-Kansas-Texas Railroad.

METHODS OF RECOVERY
TABLE 23.—Bituminous coal and lignite mined by different methods in the United States, by States, in 1943

State	From underground workings						From strip pits		Grand total production (net tons)	
	Mined by hand		Shot from the solid		Cut by machines		Total underground (net tons)	Net tons		Percent of grand total
	Net tons	Percent of total under-ground	Net tons	Percent of total under-ground	Net tons	Percent of total under-ground				
Alabama.....	574,016	3.4	2,082,156	18.4	13,077,109	78.2	16,733,281	427,039	2.5	17,160,320
Alaska.....			289,232	100.0			289,232			289,232
Arizona.....			11,281	100.0			11,281			11,281
Arkansas.....	1,140		223,189	16.8	1,190,844	84.1	1,415,173	302,762	17.6	1,717,935
Colorado.....	1,678,447	20.2	345,106	4.1	6,291,722	75.7	8,315,275	8,917	.1	8,324,192
Georgia.....			14,385	100.0			14,385			14,385
Illinois.....	113,063	.2	3,165,475	5.7	52,734,906	94.1	56,013,444	16,617,826	22.9	72,631,270
Indiana.....	167,176	1.4	241,415	2.1	11,345,526	96.5	11,754,117	13,310,466	53.1	25,064,583
Iowa.....	117,611	5.6	936,654	44.5	1,050,757	49.9	2,105,022	665,588	24.0	2,770,610
Kansas.....	47,044	11.7	80,168	19.9	276,069	68.4	403,281	3,033,500	88.3	3,436,781
Kentucky.....	2,205,622	3.6	2,532,503	4.1	56,527,964	92.3	61,266,089	1,945,384	3.1	63,211,473
Maryland.....	1,029,578	56.9			780,079	43.1	1,809,657	123,723	6.4	1,933,380
Michigan.....					168,615	100.0	168,615			168,615
Missouri.....	78,305	8.5	116,492	12.5	730,949	79.0	925,646	3,383,990	78.5	4,309,636
Montana.....	10,596	.5	9,877	.4	2,171,566	99.1	2,192,039	2,576,627	54.0	4,768,666
Montana, South Dakota, and Texas (lignite).....			178,453	100.0			78,453	170,738	68.5	249,191
New Mexico.....	439,657	23.7	264,551	14.3	1,146,619	62.0	1,850,827			1,850,827
North Dakota (lignite).....	11,387	1.5	128,133	17.1	610,940	81.4	750,480	1,749,722	70.0	2,500,202
Ohio.....	115,417	.5	95,202	.4	22,554,638	99.1	22,765,277	9,486,716	29.4	32,254,993
Oklahoma.....	3,430	.2	132,991	9.6	1,251,682	90.2	1,388,103	1,449,244	51.1	2,837,347
Oregon.....			1,200	100.0			1,200			1,200
Pennsylvania.....	14,751,969	12.0	3,807,741	3.1	104,496,619	84.9	122,056,329	17,993,485	12.8	141,049,814
Tennessee.....	589,396	8.2	1,084,004	15.1	5,503,641	76.7	7,177,041	1,877	(*)	7,178,918
Texas (bituminous).....	9,097	100.0					2,087			2,087
Utah.....	12,171	.2	128,417	1.9	6,528,348	97.9	6,656,565			6,656,565
Virginia.....	352,698	1.7	1,287,141	6.4	18,640,370	91.9	20,280,209			20,280,209
Washington.....	144,041	9.6	641,997	42.8	714,372	47.6	1,500,410	27,134	1.8	1,527,544
West Virginia.....	5,807,139	3.6	2,026,420	1.3	145,182,479	95.1	152,716,038	6,086,271	3.8	158,804,309
Wyoming.....	489,770	5.6	267,178	3.0	8,079,009	91.4	8,835,957	319,166	3.5	9,155,123
Total.....	28,448,770	5.6	20,991,381	4.1	461,051,743	90.3	510,491,894	79,685,175	13.5	590,177,069

* Some coal "Mined by hand" included under "Shot from the solid."

† Less than 0.1 percent.

TABLE 24.—*Number of coal-cutting machines in bituminous-coal and lignite mines, average output per machine, and percentage of total product of underground mines cut by machines in the United States, by States, in 1943*

State	Number of coal-cutting machines in use			Average output per machine (net tons)	Percent of total product of underground mines cut by machines
	Permissible	Other	Total		
Alabama.....	231	350	581	22,508	78.2
Arkansas.....	31	74	105	11,341	84.1
Colorado.....	154	337	491	12,814	75.7
Illinois.....	305	527	832	63,383	94.1
Indiana.....	44	207	251	45,201	96.5
Iowa.....	52	40	92	11,421	49.9
Kansas.....	17	16	33	8,366	68.4
Kentucky.....	265	716	981	57,623	92.3
Maryland.....	16	32	47	16,597	43.1
Michigan.....	7	15	22	7,664	100.0
Missouri.....	27	50	77	9,492	79.0
Montana (bituminous).....	13	54	67	32,411	99.1
New Mexico.....	44	28	72	15,925	62.0
North Dakota (lignite).....	17	4	21	29,092	81.4
Ohio.....	265	632	897	25,145	99.1
Oklahoma.....	74	90	164	7,632	90.2
Pennsylvania.....	2,078	1,035	3,113	33,568	84.9
Tennessee.....	51	183	234	23,520	76.7
Utah.....	135	57	192	33,986	97.9
Virginia.....	113	263	376	49,575	91.9
Washington.....	55	2	57	12,533	47.6
West Virginia.....	748	1,896	2,644	54,910	95.1
Wyoming.....	36	271	307	26,316	91.4
Total.....	4,777	6,879	11,656	39,555	90.3

STRIPPING OPERATIONS

TABLE 25.—Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1915

State and county	Number of strip pits	Number of power shovels			Mined by stripping (net tons)	Average number of employees			Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Steam	Electric	All others		Surface		Total			
						In strip pits	All others				
Alabama:											
Blount and Jefferson.....	3	5		1	73,749	63	15	78	281	21,884	3.37
Marion.....	1				2,098	4		4	157	628	3.34
Walker.....	6	5	2	7	351,192	200	56	256	209	53,624	6.55
Total Alabama.....	10	10	2	8	427,039	267	71	338	225	76,136	5.61
Arkansas:											
Franklin and Johnson.....	4	1		4	104,649	44	10	54	230	12,434	8.42
Sebastian.....	7			7	198,113	110	29	139	174	24,217	8.18
Total Arkansas.....	11	1		11	302,762	154	39	193	190	36,651	8.26
Colorado: Jackson.....	1			1	8,917	11	1	12	109	1,308	6.82
Illinois:											
Bureau, Grundy, Henry, Jackson and Will.....	6		20	6	2,800,460	444	328	772	288	222,705	12.57
Fulton.....	10		21	12	6,654,970	387	651	1,038	263	273,323	24.35
Knox.....	1		3	1	686,736	65	62	127	348	4,196	13.84
La Salle.....	4		3	2	149,399	30	32	62	161	9,991	14.05
Perry.....	3		13	3	2,672,819	449	240	689	244	167,933	13.92
Randolph.....	3		1	1	862,436	51	52	103	259	26,677	32.33
St. Clair.....	3		5	8	1,105,085	97	68	165	269	40,311	22.41
Saline.....	4	1	4	6	1,205,272	137	127	264	239	63,134	19.00
Schuyler.....	2			2	216,164	25	23	48	302	14,475	14.93
Vermilion.....	4		36	5	46,227	36	13	49	88	4,290	13.11
Williamson.....	2			4	238,248	24	23	47	158	7,420	28.07
Total Illinois.....	38	1	70	50	16,617,826	1,745	1,619	3,364	263	883,455	18.81

See footnotes at end of table.

TABLE 25.—Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1943—Continued

State and county	Number of strip pits	Number of power shovels			Mined by stripping (net tons)	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Steam	Electric			In strip pits	Surface		Total			
			All others	All others			All others	All others				
Indiana:	18	3	12	27	1,883,205	396	198	594	235	139,322	13.37	
Clay.....	6			13	422,955	86	36	122	211	25,718	16.45	
Davies, Knox, Martin, and Spencer.....	3			4	81,086	23	12	35	215	7,521	10.86	
Fountain.....	8	6	9	2	1,879,432	314	263	577	302	174,447	10.77	
Greene.....	2			2	222,162	51	21	72	184	13,280	16.73	
Owen.....	10	1	15	10	3,890,291	433	491	924	241	222,491	17.49	
Pike.....	5	1	4	2	714,525	122	87	209	324	67,702	10.66	
Sullivan.....	3		3	5	384,790	78	90	168	160	28,880	13.66	
Vermillion.....	7		5	10	953,749	193	134	327	190	62,223	15.33	
Vigo.....	5		9	8	2,897,371	257	262	519	292	151,565	19.12	
Warrick.....												
Total Indiana.....	67	11	59	83	13,310,466	1,953	1,594	3,547	252	892,649	14.91	
Iowa:												
Jasper and Monroe.....	2			3	21,548	15	2	17	287	4,880	4.42	
Keokuk.....	1				2,157	3		3	190	570	3.78	
Malaka.....	10		1	12	245,230	100	41	141	225	31,741	7.73	
Marion.....	9		1	15	306,050	80	36	116	236	27,408	11.17	
Van Buren.....	3				20,574	14	6	20	268	5,861	3.89	
Wapello.....	3			7	69,729	23	10	33	231	7,612	9.16	
Total Iowa.....	28		2	40	665,588	235	95	330	235	77,567	8.58	
Kansas:												
Bourbon.....	4	3	2	1	201,605	51	16	67	235	15,771	12.78	
Cherokee.....	11	5	7	6	1,104,771	236	133	369	248	91,625	12.06	
Crawford.....	15	11	12	4	1,232,281	321	144	465	246	100,353	12.28	
Labette.....	3	2		1	13,392	13	2	15	184	2,762	4.86	
Linn and Osage.....	4	3	2		481,451	52	41	93	262	24,322	19.79	
Total Kansas.....	37	24	23	12	3,033,500	673	336	1,009	233	224,833	12.92	

[illegible]

See footnotes at end of table.

TABLE 25.—Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1943—Continued

State and county	Number of strip pits	Number of power shovels			Mined by stripping (net tons)	Average number of employees			Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Steam	Electric	All others		Surface		Total			
						In strip pits	All others				
Oklahoma:											
Coal.....	2			5	47,174	53	7	60	95	5,715	8.26
Craig.....	2	1		2	17,718	15	1	16	296	4,740	8.74
Haskell, McIntosh, Muskogee, and Wagoner.....	7	3	3	3	902,738	161	82	233	275	63,968	14.11
Rogers.....	4	4	4	1	481,594	99	65	164	268	43,986	10.96
Total Oklahoma.....	15	8	7	11	1,449,244	318	155	473	250	118,409	12.24
Pennsylvania:											
Allegheny.....	45	8		72	2,399,222	555	130	685	207	141,476	16.96
Armstrong.....	16	2		35	722,292	248	113	361	165	59,412	12.16
Beaver.....	7			18	263,135	77	29	106	235	24,894	10.77
Butler.....	15	2		26	397,631	188	39	227	140	81,876	12.47
Cambria.....	27			42	642,187	364	145	509	104	56,109	11.45
Cameron, Elk, Fulton, Greene, and McKean.....	8	1		7	143,360	68	17	85	190	16,148	8.88
Centre.....	9			15	299,664	112	18	130	211	27,481	10.90
Clarion.....	22			54	2,198,438	510	183	693	210	145,318	15.13
Cleaveland.....	58	17	1	82	1,947,335	675	294	969	192	186,195	10.46
Clinton.....	4	4		8	335,156	105	41	146	280	40,939	8.19
Fayette.....	48	15		50	1,822,875	477	153	630	167	83,943	15.76
Indiana.....	16	2		30	573,174	205	127	332	133	49,531	11.57
Jefferson.....	17	1		29	688,034	231	134	365	121	44,136	12.87
Lawrence.....	6			10	146,291	53	12	65	172	11,151	13.12
Lycoming.....	2			3	24,604	6	3	9	246	2,214	11.11
Mercer.....	6			13	272,371	88	18	106	143	15,133	18.00
Somerset.....	17	1	1	33	577,874	266	142	408	122	49,674	11.66
Tioga.....	5	2		48	104,796	48	26	73	197	14,377	7.29
Venango.....	3			5	46,497	16	6	22	153	3,360	13.84
Washington.....	26	5		60	3,248,542	700	254	954	229	218,069	14.90
Westmoreland.....	47	5	3	71	1,755,107	481	171	652	139	90,864	10.32
Total Pennsylvania.....	404	65	7	670	17,993,485	5,503	2,019	7,522	174	1,312,210	13.71
South Dakota: Lignite.....	5			5	39,059	21	2	23	235	6,410	7.22
Tennessee: Fentress.....	1			2	1,877	15		15	10	5,150	12.51

Washington: Kittitas	1	1	1	1	14,568	12	12	80	940	18.20
	1	2	3	3	12,546	9	3	66	788	18.92
Total Washington.....	2	3	3	3	27,134	21	3	73	1,748	18.62
West Virginia:										
Barbour.....	9	13	13	13	232,792	142	25	167	14,338	16.24
Brooke and Ohio.....	10	2	2	2	879,537	163	65	258	43,557	20.20
Fayette.....	10	1	1	1	248,500	208	50	160	27,710	12.58
Greenbrier.....	8	3	3	3	183,381	76	13	89	13,720	13.37
Hancock.....	3	6	6	6	120,438	30	10	40	10,111	11.91
Harrison.....	44	4	4	4	3,094,983	804	295	1,094,983	169,046	18.31
McDowell.....	1	1	1	1	7,299	16	6	22	1,020	7.16
Marion.....	6	7	7	7	73,847	86	15	101	8,049	9.17
Marshall.....	1	1	1	1	62,309	12	15	12	1,884	27.76
Mingo.....	1	1	1	1	133,725	24	15	12	1,884	12.19
Monongalia.....	6	3	3	3	338,469	75	34	109	21,625	18.66
Preston.....	1	1	1	1	332,111	98	54	162	39,431	8.42
Raleigh.....	3	3	3	3	95,389	63	27	90	11,133	8.57
Randolph.....	3	4	4	4	32,520	71	6	77	6,290	6.17
Taylor.....	6	6	6	6	134,933	55	13	68	8,487	24.69
Upshur.....	1	1	1	1	27,998	10	6	15	4,425	6.24
Total West Virginia.....	111	184	184	184	6,088,271	1,963	633	2,596	388,799	18.66
Wyoming:										
Campbell and Converse.....	3	2	2	2	179,147	39	30	69	12,686	14.23
Carbon.....	3	3	3	3	140,019	58	6	64	13,337	10.50
Total Wyoming.....	6	5	5	5	319,166	97	36	133	25,923	12.31
Total United States.....	1,004	1,433	1,433	1,433	79,685,176	16,643	8,337	24,980	5,269,624	16.15

¹ On returns from mines combining stripping and underground methods in same operation, the tonnage has been separated and the figures on employment prorated so that this table includes only data pertaining to strip mining.

TABLE 26.—*Summary of operations of power strip pits proper in the bituminous-coal and lignite fields of the United States, by States, in 1943*

State	Number of strip pits	Number of power shovels			Mined by stripping (net tons)	Number of men employed	Average number of days mines were active	Average tons per man per day
		Steam	Electric	All others				
Power strip pits proper:								
Alabama.....	9	10	2	8	424,941	334	226	5.63
Arkansas.....	9	1		11	299,542	184	193	8.43
Colorado.....	1			1	8,917	12	109	6.82
Illinois.....	38	1	70	50	16,617,826	3,364	263	18.81
Indiana.....	60	11	59	83	13,292,178	3,531	252	14.95
Iowa.....	25		2	40	655,876	316	237	8.76
Kansas.....	33	24	23	12	3,028,132	995	234	13.03
Kentucky.....	22	2	4	39	1,941,440	700	160	17.38
Maryland.....	4			11	117,618	76	121	12.76
Missouri.....	41	12	21	39	3,380,707	1,078	254	12.37
Montana (bituminous).....	1		7		2,576,627	107	318	75.73
Montana and Texas (lignite).....	3	2		2	131,415	26	264	19.16
North Dakota (lignite).....	29	7	11	33	1,734,704	428	228	17.78
Ohio.....	125	14	16	224	9,450,351	2,821	232	14.45
Oklahoma.....	12	8	7	11	1,443,755	460	252	12.47
Pennsylvania.....	386	65	7	670	17,924,437	7,340	177	13.80
South Dakota (lignite).....	4			5	38,909	22	243	7.27
Tennessee.....	1			2	1,877	15	10	12.51
Washington.....	2			3	27,134	24	73	15.52
West Virginia.....	108	12	3	184	6,081,663	2,573	150	15.72
Wyoming.....	5	3	2	5	316,475	129	198	12.42
Total from power strip pits proper.....	918	172	234	1,433	79,494,524	24,535	212	15.25
Horse stripping operations.....	86				190,651	445	103	4.15
Grand total.....	1,004	172	234	1,433	79,685,175	24,980	211	15.15

POWER DRILLING

TABLE 27.—Summary of operations of underground bituminous-coal and lignite mines where shot holes were power-drilled in the United States, by States, in 1943

State	Number of mines using power drills		Number of power drills						Net tons produced in working places where shot holes were power-drilled				Total production from mines using power drills (net tons)		
	In coal and rock		Electric			Compressed air			Electric drills	Compressed-air drills	Total	In coal and rock	In rock only	Total	
			In coal and rock	In rock only	Total	In coal and rock	In rock only	Total							
Alabama.....	53	6	668	166	17	851	24	137	10,608,801	157,844	10,608,801	12,404,509	283,371	12,777,880	
Alaska.....	2	3	10	3	2	15	24	5	231,580	57	231,580	102,755	886,547	1,118,127	
Arkansas.....	3	21	270	72	4	346	1	58	4,681,479	1,473	4,682,952	6,183,715	686,886	6,870,601	
Colorado.....	127	2	934	132	11	1,077	9	28	50,487,512	380,905	50,848,417	53,610,555	298,806	53,909,361	
Illinois.....	33	11	184	70	7	261	9	5	10,501,445	395,048	10,501,445	10,637,421	298,806	10,936,227	
Indiana.....	11	3	29	9	38	4	29	38	305,048	149,070	39,300,207	46,509,677	4,866,972	51,376,649	
Iowa.....	29	3	807	183	78	1,068	10	129	39,151,137	239,069	39,390,206	43,338	114,199	114,199	
Kansas.....	108	22	14	3	5	22	5	4	74,486	145,652	145,652	145,652	198,603	344,255	
Kentucky.....	4	4	5	5	6	6	4	4	2,046,404	19,457	2,065,861	2,065,861	2,065,861	2,065,861	
Maryland.....	1	4	42	8	1	51	2	3	853,557	1,114,363	1,114,363	1,114,363	1,114,363	1,114,363	
Michigan.....	4	4	34	42	4	34	4	4	398,718	398,718	398,718	392,356	507,918	17,503,422	
Missouri.....	13	4	11	8	19	19	7	7	16,003,765	6,000	16,003,765	17,055,504	225,398	17,280,902	
Montana (bituminous and lignite).....	50	4	48	15	14	77	83	1	56,506,146	3,610,642	56,505,180	75,462,165	15,603,922	91,090,067	
New Mexico.....	9	4	48	15	14	77	83	1	52,894,518	2,012,952	52,894,518	3,375,749	1,113,357	4,489,106	
North-South Dakota (lignite).....	168	55	1,199	308	76	1,583	1	41	2,012,952	7,636,595	6,505,509	6,505,509	3,969,356	14,169,781	
Ohio.....	24	9	102	2	5	109	187	24	6,505,509	790,606	7,636,595	10,200,425	16,284,468	128,717,910	
Oklahoma.....	25	33	185	1	1	187	27	123	493,012	1,033,517	80,007,011	112,433,422	16,284,468	8,764,880	
Pennsylvania.....	25	33	182	2	11	195	96	10	78,973,494	76,304	8,752,278	8,752,278	44,925,624	415,514,075	
Tennessee.....	33	11	182	1	11	195	96	10	263,599,050	6,205,878	269,804,928	370,588,451	44,925,624	415,514,075	
Utah.....	37	17	1,717	229	76	2,027	15	9	8,675,974	11,630	8,675,974	8,675,974	8,675,974	8,675,974	
Virginia.....	301	56	1,717	229	76	2,027	15	9	263,599,050	6,205,878	269,804,928	370,588,451	44,925,624	415,514,075	
Washington.....	17	27	390	16	1	407	4	7	1,369	28	1,369	28	1,369	28	
West Virginia.....	27	27	390	16	1	407	4	7	1,369	28	1,369	28	1,369	28	
Wyoming.....	1,178	198	7,288	1,304	338	8,930	233	28	1,369	28	1,369	28	1,369	28	
Total.....	1,178	198	7,288	1,304	338	8,930	233	28	1,369	28	1,369	28	1,369	28	

MECHANICAL LOADING

Devices for loading coal mechanically in underground bituminous-coal and lignite mines are divided into two types: Those that completely mechanize the loading, practically eliminating hand shoveling, and those that greatly reduce the labor involved in hand shoveling. Devices in the first category include mobile loaders, scrapers, and self-loading conveyors or duckbills and are designated as "machines." Those in the second category include all types of hand-loaded face conveyors and pit-car loaders and are designated as "conveyors."

During 1938, the first year complete data were available on mechanical loading by types of devices, 68 percent of the underground mechanically loaded tonnage was loaded by "machines" or mobile loaders, scrapers, and duckbills, and 32 percent was handled by "conveyors" or hand-loaded conveyors and pit-car loaders. In 1943 these percentages were 81 percent for "machines" and 19 percent for "conveyors."

The following tables (28 to 33, inclusive) showing detailed statistics on mechanical loading pertain only to underground mines and do not include strip mines or data on coal handled on the surface.

Sales of mechanical loading equipment in 1944.—The estimated capacity of mechanical loading equipment sold for underground use in all coal mines was 6 percent more in 1944 than in 1943. Table 28 shows the sales reported, by type of equipment, and the number of manufacturers reporting for 1937-44.

Sales of conveyors to bituminous-coal and lignite mines in 1944 totaled 580 units. The figures for 1942-44 exclude duckbills, which were included in all previous years. Therefore, these sales are not comparable with those for 1941 or earlier years. By excluding sales of duckbills, some of the overlapping sales of conveyors were eliminated. However, it appears that a certain amount of overlapping remains; for instance, in 1942 there were 4,103 conveyors (hand-loaded and those equipped with duckbills) in active use in bituminous-coal and lignite mines, as reported by mine operators. By adding 1942 conveyor sales of 1,167 units, 5,270 units appeared available for use in 1943, whereas the actual number reported in use by mine operators was 4,417, or 853 less. This difference represents idle or worn-out and obsolete equipment, duplications in reporting sales, and a small number of conveyors used in conjunction with mobile loaders.

The number of mobile loaders, scrapers, and conveyors (shipped into the various States and groups of States in 1944) and the number of units in actual use in 1943 are shown in table 30.

Statistics on mechanical loading in bituminous-coal and lignite mines in 1943.—During 1943 the approximate percentage of the tonnage loaded by each type of equipment was as follows: Mobile loaders, 72; hand-loaded conveyors, 17; duckbills, 9; pit-car loaders, 1; and scrapers, 1.

Mobile loaders handle more coal than all the other types of mechanical loading devices combined. Where coal is loaded by mobile loaders it is most commonly loaded directly into mine cars, but some tonnage is loaded into shuttle cars or onto conveyors. During 1943, 80 percent of the bituminous coal and lignite handled by mobile loaders was

loaded into mine cars, 17 percent into shuttle cars, and 3 percent onto conveyors.

During 1943 in underground bituminous-coal and lignite mines 2,525 mobile loaders handled 179,008,477 tons—an average of 70,894 tons per mobile loader per year; scrapers averaged 16,258; pit-car loaders, 8,314; duckbills, 18,692; and hand-loaded face conveyors, 13,746 per year per unit for the same period (see tables 29 and 31).

Mechanical loading, by States.—West Virginia has been the leading producer of mechanically loaded coal since 1939. During 1943 West Virginia produced 74,517,853 tons of mechanically loaded coal, followed by Illinois with 47,420,744, Pennsylvania with 42,653,020, Kentucky with 19,583,421, and Ohio with 15,320,808 tons. These five States produced 80 percent of the total output of underground mechanically loaded bituminous coal in the United States in 1943.

Detailed data, by States, on the number of mines and machines and the production of mechanically loaded coal compared with the total production at mines using mechanical loading devices are given in table 32. Comparative changes in underground mechanical loading in 1942–43, by States, are shown in table 33.

Table 34 shows bituminous coal and lignite mined by stripping compared with underground hand-loaded and machine-loaded tonnage, by States, for 1943.

TABLE 28.—Units of mechanical loading equipment sold to bituminous-coal and lignite mines for underground use in the United States, as reported by manufacturers, 1937–44

	1937	1938	1939	1940	1941	1942	1943	1944	Change, 1944 from 1943 (percent)
Type of equipment:									
Mobile loaders.....	292	241	292	233	367	352	234	282	+20.5
Scrapers.....	13	6	18	36	8	15	13	20	+53.8
Conveyors.....	835	749	1,095	1,573	1,800	1,167	798	580	-27.3
Pit-car loaders.....	32	139	2	3	10	2	1		
Total, all types.....	1,172	1,135	1,407	1,845	2,185	1,536	1,046	882	-15.7
Number of manufacturers reporting.....	29	29	31	32	32	28	24	22	

¹ Reported as scrapers or scraper haulers and hoists.

² Includes hand-loaded conveyors and those equipped with duckbills or other self-loading heads. Sales of both loading heads and shaker conveyors were counted for the years 1937–41, inclusive; but figures for 1942, 1943, and 1944 do not include loading heads separately.

TABLE 29.—Units of mechanical loading equipment in use in underground bituminous-coal and lignite mines in the United States, 1938–43

	1938	1939	1940	1941	1942	1943	Change, 1943 from 1942 (percent)
Type of equipment:							
Mobile loaders.....	1,405	1,573	1,720	1,985	2,301	2,525	+ 9.7
Scrapers.....	117	131	116	109	93	83	-10.8
Pit-car loaders.....	1,392	873	697	607	481	321	-33.3
Conveyors equipped with duckbills or other self-loading heads.....	346	559	656	788	1,062	1,226	+15.4
Hand-loaded conveyors.....	1,526	1,834	2,263	2,807	3,041	3,191	+4.9
Total, all types.....	4,786	4,970	5,452	6,296	6,978	7,346	+5.3

TABLE 30.—Comparison of mobile loaders, scrapers, and conveyors in actual use in bituminous-coal and lignite mines in the United States in 1943 with sales reported for 1944, by States and regions

State and region	Mobile loaders		Scrapers		Conveyors ¹	
	In use in 1943	Sales in 1944	In use in 1943	Sales in 1944	In use in 1943	Sales in 1944
Northern Appalachian States:						
Pennsylvania.....	536	86	7	4	880	70
Maryland.....					27	3
Ohio.....	163	4			235	16
Michigan.....					5	
Southern Appalachian States:						
Alabama.....	80	12	48		398	44
Kentucky.....	184	33		1	347	147
Tennessee.....	6	5			126	39
West Virginia.....	594	76	6	8	1,242	178
Virginia.....	47	9		3	134	19
Middle Western States:						
Illinois.....	567	29			31	4
Indiana.....	169	14				
Trans-Mississippi States ²	179	14	22	4	992	60
Total.....	2,525	282	83	20	4,417	580

¹ Includes hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads.

² Includes Arkansas, Colorado, Iowa, Missouri, Montana, New Mexico, North Dakota, Oklahoma, Utah, Washington, and Wyoming.

TABLE 31.—Bituminous coal and lignite mechanically loaded underground in the United States, by types of machines, 1942-43

Type of equipment	1942		1943	
	Net tons	Percent of total	Net tons	Percent of total
Mobile loaders.....	160,300,935	68.8	179,008,477	71.7
Scrapers.....	1,404,569	.6	1,349,435	.6
Pit-car loaders.....	3,251,469	1.4	2,668,674	1.1
Conveyors equipped with duckbills or other self-loading heads.....	20,683,558	8.9	22,916,590	9.2
Hand-loaded conveyors.....	47,262,389	20.3	43,862,038	17.5
Grand total loaded mechanically.....	232,902,920	100.0	249,805,214	100.0

TABLE 32.—Mechanical loading underground in bituminous-coal and lignite mines in the United States, by States, in 1943

State	Number of mines				Number of machines				Production mechanically loaded (net tons)				Total underground production at mines using mechanical loading devices (net tons)		
	Using loading machines ¹	Using conveyors only ²	Using both loading machines and conveyors	Total	Mobile loading machines	Scrapers	Conveyors equipped with duckbills or other self-loading heads	Pit-car loaders	Handled by conveyors ³	Total	Mines using loading machines only ¹	Mines using conveyors only ²	Mines using both loading machines and conveyors	Total	
Alabama.....	19	20	9	48	80	43	29	6	4,050,427	8,328,455	5,194,053	3,528,522	4,134,057	12,856,532	
Arkansas.....	22	22	3	47	27	2	170	1	995,929	995,929	1,003,865	1,003,865	1,003,865	1,003,865	
Colorado.....	33	18	3	54	68	2	11	1	3,305,913	3,333,952	4,744,815	404,327	404,327	5,962,634	
Illinois.....	54	3	11	68	567	20	20	118	46,456,742	628,039	47,420,744	408,676	6,457,624	50,866,303	
Indiana.....	22	2	2	25	169	2	20	20	10,211,666	181,864	10,393,430	65,922	576,064	10,396,671	
Iowa.....	3	1	2	6	2	2	14	11	218,353	52,898	258,677	173,974	173,974	432,651	
Kentucky.....	59	32	13	104	184	167	25	180	2,661,762	19,583,421	18,631,107	4,432,585	7,034,671	30,098,363	
Maryland.....	2	2	1	5	3	1	1	26	16,921,559	2,278,030	178,942	114,199	216,951	394,363	
Michigan.....	1	1	1	3	1	1	1	5	(⁴)	74,486	114,199	114,199	216,951	114,199	
Montana (bituminous and lignite).....	9	4	1	14	47	13	7	6	2,008,546	10,000	1,848,712	190,986	2,039,698	2,039,698	
New Mexico.....	4	4	4	12	11	7	13	1	764,520	387,802	1,114,353	1,114,353	1,114,353	1,114,353	
North Dakota (lignite).....	28	1	5	34	163	176	155	59	14,442,391	878,417	14,813,097	35,298	16,463,835	16,463,835	
Ohio.....	82	72	24	178	536	7	88	60	31,743,501	10,900,519	48,286,044	15,201,475	1,615,440	74,048,173	
Pennsylvania.....	4	20	6	30	6	151	107	19	481,673	1,495,495	5,146,051	2,732,691	10,467,074	14,285,922	
Tennessee.....	12	4	6	22	58	107	35	35	5,892,437	278,114	5,146,094	152,151	1,044,685	6,342,910	
Utah.....	12	8	7	27	47	2	116	18	2,805,949	1,897,175	4,703,124	1,666,699	7,678,366	7,678,366	
Virginia.....	12	6	1	19	11	14	86	78	188,200	692,420	287,000	718,828	14,376	1,020,204	
Washington.....	126	112	67	305	594	6	188	78	55,648,810	18,890,043	58,030,278	24,420,522	39,391,295	111,851,065	
West Virginia.....	15	4	3	22	23	7	245	49	7,991,518	621,288	7,620,682	29,391,295	29,391,295	8,674,515	
Wyoming.....	490	338	160	988	2,625	83	1,226	321	203,274,502	46,530,712	225,162,653	56,610,765	65,019,544	346,792,953	
Total 1943.....	470	355	151	976	2,301	93	1,062	481	182,389,062	50,513,858	213,799,986	63,987,688	60,154,352	337,912,026	
Percent change, 1943 from 1942.....	+4.3	-4.8	+6.0	+1.2	+9.7	-10.8	+15.4	-33.3	+11.5	-7.9	+5.3	-11.5	+8.1	+2.6	

¹ Includes mobile loaders, scrapers, and conveyors equipped with duckbills or other self-loading heads. Some mines in this class also use conveyors or shuttle cars in conjunction with mobile loaders to perform initial phase of transportation.

² Includes hand-loaded conveyors and pit-car loaders.

³ Number of units.

⁴ In Maryland "Handled by conveyors" includes small amount "Loaded by machine."

TABLE 83.—Comparative changes in underground mechanical loading of bituminous coal and lignite by principal types of machines in the United States, by States, 1942-43

State	Net tons				Handled by each class (percent)				Underground output mechanically loaded (percent)	
	1942		1943		1942		1943			
	Loaded by machines ¹	Handled by conveyors ²	Total	Loaded by machines ¹	Handled by conveyors ²	Total	Loaded by machines ¹	Handled by conveyors ²		
Alabama.....	3,641,336 (¹)	5,146,771 (¹)	8,788,107 (¹)	4,050,427 (¹)	4,278,028 (¹)	8,328,455 (¹)	41.4 (¹)	58.6 (¹)	46.3 (¹)	49.8 (¹)
Arkansas.....	3,059,744 (¹)	774,694 (¹)	3,834,438 (¹)	3,305,913 (¹)	628,039 (¹)	3,933,952 (¹)	79.8 (¹)	20.2 (¹)	70.4 (¹)	70.4 (¹)
Colorado.....	40,301,338 (¹)	1,151,832 (¹)	41,453,170 (¹)	46,456,742 (¹)	964,002 (¹)	47,420,744 (¹)	97.2 (¹)	2.8 (¹)	47.5 (¹)	47.3 (¹)
Illinois.....	8,968,001 (¹)	156,278 (¹)	9,124,279 (¹)	10,211,566 (¹)	181,864 (¹)	10,393,430 (¹)	98.3 (¹)	1.7 (¹)	84.2 (¹)	88.4 (¹)
Indiana.....	14,452,385 (¹)	2,478,739 (¹)	16,931,124 (¹)	16,921,659 (¹)	2,661,762 (¹)	19,583,421 (¹)	85.4 (¹)	14.6 (¹)	13.6 (¹)	13.4 (¹)
Iowa.....	1,867,655 (¹)	1,867,655 (¹)	3,735,310 (¹)	2,008,846 (¹)	74,486 (¹)	2,083,332 (¹)	100.0 (¹)	0.0 (¹)	27.8 (¹)	32.0 (¹)
Kentucky.....	1,867,655 (¹)	1,867,655 (¹)	3,735,310 (¹)	2,008,846 (¹)	74,486 (¹)	2,083,332 (¹)	100.0 (¹)	0.0 (¹)	15.4 (¹)	15.4 (¹)
Maryland.....	1,867,655 (¹)	1,867,655 (¹)	3,735,310 (¹)	2,008,846 (¹)	74,486 (¹)	2,083,332 (¹)	100.0 (¹)	0.0 (¹)	31.0 (¹)	44.2 (¹)
Michigan.....	1,867,655 (¹)	1,867,655 (¹)	3,735,310 (¹)	2,008,846 (¹)	74,486 (¹)	2,083,332 (¹)	100.0 (¹)	0.0 (¹)	90.1 (¹)	91.4 (¹)
Montana (bituminous and lignite).....	1,867,655 (¹)	1,867,655 (¹)	3,735,310 (¹)	2,008,846 (¹)	74,486 (¹)	2,083,332 (¹)	100.0 (¹)	0.0 (¹)	29.4 (¹)	41.3 (¹)
New Mexico.....	1,867,655 (¹)	1,867,655 (¹)	3,735,310 (¹)	2,008,846 (¹)	74,486 (¹)	2,083,332 (¹)	100.0 (¹)	0.0 (¹)	48.2 (¹)	51.7 (¹)
North Dakota (lignite).....	14,324,083 (¹)	1,127,264 (¹)	15,451,347 (¹)	14,442,000 (¹)	878,417 (¹)	15,320,417 (¹)	92.7 (¹)	7.3 (¹)	67.3 (¹)	67.3 (¹)
Ohio.....	30,205,382 (¹)	11,933,944 (¹)	42,139,326 (¹)	31,743,501 (¹)	10,900,519 (¹)	42,653,020 (¹)	100.0 (¹)	0.0 (¹)	65.9 (¹)	54.6 (¹)
Oklahoma.....	4,190,480 (¹)	2,224,900 (¹)	6,415,380 (¹)	5,682,437 (¹)	1,495,495 (¹)	7,177,932 (¹)	10.4 (¹)	89.6 (¹)	45.1 (¹)	54.6 (¹)
Pennsylvania.....	2,784,400 (¹)	644,303 (¹)	3,428,703 (¹)	2,805,949 (¹)	1,897,175 (¹)	4,703,124 (¹)	89.8 (¹)	10.2 (¹)	25.6 (¹)	31.8 (¹)
Tennessee.....	2,784,400 (¹)	644,303 (¹)	3,428,703 (¹)	2,805,949 (¹)	1,897,175 (¹)	4,703,124 (¹)	89.8 (¹)	10.2 (¹)	22.5 (¹)	27.4 (¹)
Utah.....	86,008 (¹)	19,964,558 (¹)	20,050,566 (¹)	158,290 (¹)	692,429 (¹)	7,850,719 (¹)	8.5 (¹)	91.5 (¹)	59.7 (¹)	89.4 (¹)
Virginia.....	50,117,333 (¹)	7,707,139 (¹)	57,824,472 (¹)	55,648,810 (¹)	18,869,043 (¹)	74,517,853 (¹)	71.5 (¹)	28.5 (¹)	23.1 (¹)	23.2 (¹)
West Virginia.....	6,942,283 (¹)	967,856 (¹)	7,910,139 (¹)	7,991,518 (¹)	621,288 (¹)	8,612,806 (¹)	90.2 (¹)	9.8 (¹)	52.6 (¹)	56.7 (¹)
Wyoming.....	481,251 (¹)	481,251 (¹)	962,502 (¹)	203,274,502 (¹)	46,530,712 (¹)	249,805,214 (¹)	78.3 (¹)	21.7 (¹)	45.7 (¹)	48.8 (¹)
Undistributed:									97.0 (¹)	97.5 (¹)
East of Mississippi River.....	3,083,971 (¹)	1,241,128 (¹)	4,325,099 (¹)	203,274,502 (¹)	46,530,712 (¹)	249,805,214 (¹)	78.3 (¹)	21.7 (¹)	45.2 (¹)	48.9 (¹)
West of Mississippi River.....	182,389,062 (¹)	50,513,838 (¹)	232,902,900 (¹)	203,274,502 (¹)	46,530,712 (¹)	249,805,214 (¹)	78.3 (¹)	21.7 (¹)	45.2 (¹)	48.9 (¹)
Total.....	182,389,062 (¹)	50,513,838 (¹)	232,902,900 (¹)	203,274,502 (¹)	46,530,712 (¹)	249,805,214 (¹)	78.3 (¹)	21.7 (¹)	45.2 (¹)	48.9 (¹)

¹ Includes mobile loaders, scrapers, and duck-bills.² Includes hand-loaded conveyors and pit-car loaders.³ Included under "Undistributed" to avoid disclosing individual operations.⁴ In Maryland "Handled by conveyors" includes small amount "loaded by machines."⁵ Included in total; percentage by types not given because State groups not comparable.

TABLE 34.—*Bituminous coal and lignite in the United States mined underground and from strip pits and method of loading underground, in net tons, by States, in 1943*

State	Mined by stripping	Mined underground			Grand total production
		Hand-loaded	Machine-loaded	Total	
Alabama.....	427, 089	8, 404, 826	8, 328, 455	16, 733, 281	17, 160, 320
Alaska.....		289, 232		289, 232	289, 232
Arizona.....		11, 281		11, 281	11, 281
Arkansas.....	302, 762	419, 244	995, 929	1, 415, 173	1, 717, 935
Colorado.....	8, 917	4, 381, 323	3, 933, 952	8, 315, 275	8, 324, 192
Georgia.....		14, 385		14, 385	14, 385
Illinois.....	16, 617, 826	8, 592, 700	47, 420, 744	56, 013, 444	72, 631, 270
Indiana.....	13, 310, 466	1, 360, 687	10, 393, 430	11, 754, 117	25, 064, 583
Iowa.....	665, 588	1, 823, 766	281, 256	2, 105, 022	2, 770, 610
Kansas.....	3, 033, 500	403, 281		403, 281	3, 436, 781
Kentucky.....	1, 945, 384	41, 682, 668	19, 583, 421	61, 266, 089	63, 211, 473
Maryland.....	123, 723	1, 531, 627	278, 030	1, 809, 657	1, 933, 380
Michigan.....		94, 129	74, 486	168, 615	168, 615
Missouri.....	3, 383, 960	925, 646		925, 646	4, 309, 636
Montana (bituminous).....	2, 576, 627	187, 703	2, 004, 336	2, 192, 039	4, 768, 666
Montana and Texas (lignite).....	131, 679	62, 338	14, 510	76, 848	208, 527
New Mexico.....		1, 086, 207	764, 620	1, 850, 827	1, 850, 827
North Dakota (lignite).....	1, 749, 722	362, 678	387, 802	750, 480	2, 500, 202
Ohio.....	9, 489, 716	7, 444, 469	15, 320, 808	22, 765, 277	32, 254, 993
Oklahoma.....	1, 449, 244	629, 909	758, 194	1, 388, 103	2, 837, 347
Oregon.....		1, 200		1, 200	1, 200
Pennsylvania.....	17, 983, 485	80, 403, 309	42, 653, 020	123, 056, 329	141, 049, 814
South Dakota (lignite).....	39, 059	1, 605		1, 605	40, 664
Tennessee.....	1, 877	5, 209, 873	1, 967, 168	7, 177, 041	7, 178, 918
Texas (bituminous).....		9, 097		9, 097	9, 097
Utah.....		705, 385	5, 960, 551	6, 665, 936	6, 665, 936
Virginia.....		15, 577, 085	4, 703, 124	20, 280, 209	20, 280, 209
Washington.....	27, 134	649, 691	850, 719	1, 500, 410	1, 527, 544
West Virginia.....	6, 088, 271	78, 198, 185	74, 517, 853	152, 716, 038	158, 804, 309
Wyoming.....	319, 166	223, 151	8, 612, 806	8, 835, 957	9, 155, 123
Total.....	79, 685, 175	260, 686, 680	249, 805, 214	510, 491, 894	590, 177, 069

MECHANICAL CLEANING

In 1927, the first year complete data were collected on mechanical cleaning of bituminous coal, 5 percent (27,692,047 tons) of the total output was cleaned. This percentage has increased each year, and in 1943 almost 25 percent was cleaned.

Reports on sales of bituminous-coal-cleaning equipment show that installations were made in 12 States in 1944 compared with 10 States in 1943. It was estimated that the 1944 sales of cleaning equipment increased the capacity for bituminous-coal cleaning by 5,400 tons of cleaned coal per hour compared with an increase of 3,500 tons in 1943.

Tables 35, 36, 39, and 40 include mechanical cleaning data on all coal mined in the United States except Pennsylvania anthracite. Tables 37 and 38 are upon the same basis but do not include consumer-operated plants. There are no mechanical cleaning plants at lignite mines.

Consumer-operated plants include plants owned by steel companies which receive coal from various mines (but usually from affiliated companies), clean it, and then consume it directly at the plant.

Coal cleaned at consumer-operated plants was tabulated in the State where the plant was located. All coal cleaned at plants other than consumer-operated plants was included in the State from which the coal was mined.

Table 35 compares bituminous coal cleaned in 1940-43, inclusive, by method of cleaning. Both wet and pneumatic methods increased in 1943 over 1942.

Mechanical cleaning by types of equipment.—The quantity of bituminous coal cleaned by wet-washing methods reached 124,374,775 tons in 1943—an increase of 1.9 percent over 1942. The quantity cleaned by pneumatic methods was 21,201,074 tons—an increase of 5 percent.

Table 36 compares the number of cleaning plants and tons of cleaned coal, by types of equipment, for 1942 and 1943. During 1943, 403 wet-washing and 83 pneumatic cleaning plants were in operation. Fifty-four tipples used both wet and dry methods at the same plant; deducting these duplications gives a net total of 432 plants that cleaned coal in 1943 compared with 438 in 1942.

Wet methods of cleaning coal include piston- or common-type jigs, Baum-type jigs, concentrating tables, and launders and upward-current classifiers, and any combinations of these four methods. Baum-type jigs cleaned approximately 39 percent of the total coal cleaned by wet methods during 1943.

Pneumatic methods of coal cleaning include air tables, air flow, and air sand, and any combinations of these three methods. During 1943 air tables cleaned 63 percent of the coal cleaned by pneumatic methods.

Mines served by cleaning plants, exclusive of those that ship to washeries operated by steel companies, produced 222,898,414 tons or 37.8 percent of the total bituminous output in 1943. In this same group of mines, 135,608,665 tons were mechanically cleaned; therefore 60.8 percent of the coal produced at mines with cleaning plants in 1943 was cleaned at the mine. The rest of the output (39.2 percent) presumably represents the larger sizes commonly picked by hand.

Table 37 shows total production of coal at mines with cleaning plants by methods of preparation in 1942 and 1943.

Coal cleaning by States.—The following States led in volume of coal mechanically cleaned in the United States in 1943: Pennsylvania, 24.3 percent of total; West Virginia, 21.7; Illinois, 20.8; Alabama, 9.2; and Indiana, 6.6 percent. These five States accounted for 82.6 percent of the total mechanically cleaned coal in 1943. Table 39 shows the number of plants in operation, tons of clean coal, and percentage of State output mechanically cleaned in 1942 and 1943.

Relation between raw coal, clean coal, and refuse.—For every 100 tons of raw coal cleaned during 1943 at the mines, 86.5 tons of clean merchantable coal, on an average, were obtained, and 13.5 tons of refuse were discarded. Table 40 shows total production of mines with cleaning plants and results of cleaning operations, by States.

Methods of mining at mines served by cleaning plants.—Mechanical loading, both in underground mines and strip pits, appears to be closely related to mechanical cleaning. Table 38 shows the mining methods at mines having cleaning plants. Production of coal from strip mines in 1943 was 79,685,175 tons (see table 34), of which 30,326,426 tons (38.1 percent) came from strip mines having mechanical cleaning tipples. Underground coal loaded mechanically in 1943 totaled 249,805,214 tons, of which 125,313,683 tons (50.2 percent) passed through tipples equipped with mechanical-cleaning devices. Hand-loaded underground coal production in 1943 totaled 260,686,680 tons, of which 25.8 percent passed through tipples equipped with leaning plants.

TABLE 35.—*Bituminous coal mechanically cleaned by wet and pneumatic methods in the United States in net tons of clean coal, 1940-43*

Method of cleaning	1940	1941	1942	1943	Change, 1943 from 1942 (percent)
By wet methods:					
At mines.....	78,539,869	91,126,091	111,210,109	114,407,591	+2.9
At consumer-operated cleaning plants.....	8,750,220	9,251,543	10,789,749	9,967,184	-7.6
Total wet methods.....	87,290,089	100,377,634	121,999,858	124,374,775	+1.9
By pneumatic methods.....	14,979,664	17,161,888	20,187,488	21,201,074	+5.0
Grand total.....	102,269,753	117,539,522	142,187,346	145,575,849	+2.4

TABLE 36.—*Bituminous coal cleaned in the United States, by types of equipment in actual operation, 1942-43*

[Coal cleaned and plants operated by consumers at central washeries in Colorado and Pennsylvania included]

Type of equipment	Plants in operation		Net tons of clean coal		Cleaned by each type (percent of total)	
	1942	1943	1942	1943	1942	1943
Wet methods:						
Jigs.....	220	214	66,875,931	66,091,816	47.0	45.4
Concentrating tables.....	16	13	3,138,365	2,929,389	2.2	2.0
Jigs in combination with concentrating tables.....	15	17	4,366,100	4,321,871	3.1	2.9
Jigs in combination with launders and upward-current classifiers.....	14	18	5,594,983	7,990,536	3.9	5.5
Launders and upward-current classifiers.....	141	141	42,024,479	43,041,163	29.6	29.6
Total wet methods.....	406	403	121,999,858	124,374,775	85.8	85.4
Pneumatic methods.....	84	83	20,187,488	21,201,074	14.2	14.6
Grand total.....	490	486	142,187,346	145,575,849	100.0	100.0

¹ Number of plants using both wet and pneumatic methods was 52 in 1942 and 54 in 1943.TABLE 37.—*Total production of all coal at bituminous mines in the United States having cleaning plants, in net tons, 1942-43*

[Does not include any estimate for mines that may ship to consumer-operated plants]

Type of equipment	1942	1943	Change, 1943 from 1942 (percent)
Wet methods:			
Jigs.....	103,929,379	105,008,091	+1.0
Concentrating tables.....	2,795,456	2,751,785	-1.6
Jigs in combination with concentrating tables.....	4,855,537	4,920,211	+1.5
Jigs in combination with launders and upward-current classifiers.....	8,948,388	13,657,798	+52.6
Launders and upward-current classifiers.....	82,712,948	82,518,056	-2.2
Total wet methods.....	203,241,708	208,861,941	+2.8
Pneumatic methods.....	53,367,701	55,693,125	+4.4
Grand total.....	256,609,409	264,555,066	+3.1
Less duplication ¹	38,535,518	41,656,652	+8.1
Net total.....	218,073,891	222,898,414	+2.2
United States, total production ²	582,692,937	590,177,069	+1.3
Percent produced at mines having cleaning plants.....	37.4	37.8	.....

¹ Mines using both wet and pneumatic methods.² For purposes of historical comparison and statistical convenience, figures include output of lignite and of anthracite and semianthracite outside of Pennsylvania. There are no mechanical cleaning plants at lignite mines.

TABLE 38.—*Method of mining at bituminous-coal mines in the United States served by cleaning plants, 1940-43*

[Does not include any estimate for mines that may ship to consumer-operated plants]

Method of mining in use	Total net tons produced from mines that move coal to cleaning plants ¹				Change, 1943 from 1942 (percent)
	1940	1941	1942	1943	
Mined from strip pits.....	20,029,770	24,773,543	28,597,289	30,326,426	+6.0
Mechanically loaded underground....	66,148,465	93,373,789	118,917,178	125,313,683	+5.4
Hand-loaded underground.....	75,557,899	67,320,837	70,559,424	67,258,305	-4.7
Total.....	161,736,134	185,468,169	218,073,891	222,898,414	+2.2

¹ Based upon shipping weights and includes some marketable coal that did not pass through cleaning plants.TABLE 39.—*Bituminous coal mechanically cleaned by wet and pneumatic methods in the United States, by States, 1942-43*

[Coal cleaned and plants operated by consumers at central washeries in Colorado and Pennsylvania included]

State	Plants in operation		Net tons of clean coal		Output mechanically cleaned (percent)	
	1942	1943	1942	1943	1942	1943
Alabama.....	57	54	15,697,911	13,326,372	81.3	77.7
Alaska.....	1	2	73,417	100,780	28.1	34.8
Arkansas.....	2	2	(¹)	35,638	-----	2.1
Colorado.....	9	8	1,157,313	1,180,248	14.3	14.2
Georgia.....	1	-----	(¹)	-----	-----	-----
Illinois.....	56	53	27,206,284	30,321,306	41.8	41.7
Indiana.....	17	19	9,082,500	9,612,008	35.8	38.3
Kansas.....	7	7	2,565,936	1,845,362	60.7	53.7
Kentucky.....	20	19	4,622,553	6,896,774	7.4	10.9
Michigan.....	1	1	(¹)	25,290	-----	15.0
Missouri.....	10	10	1,487,060	2,334,203	42.2	54.2
Montana.....	3	2	(¹)	146,503	-----	3.1
New Mexico.....	1	1	90,738	53,703	5.4	2.9
Ohio.....	10	10	6,022,900	6,611,721	18.4	20.5
Oklahoma.....	-----	2	-----	108,942	-----	3.8
Pennsylvania ²	62	67	35,712,262	35,429,650	24.8	25.1
Tennessee.....	6	5	455,413	438,168	5.6	6.1
Utah.....	3	2	1,413,048	839,111	25.6	12.6
Virginia.....	22	21	3,062,674	3,292,751	15.2	16.2
Washington.....	21	23	1,726,599	1,347,160	88.4	88.2
West Virginia ³	129	124	31,607,271	31,630,159	20.3	19.9
Undistributed:	-----	-----	-----	-----	-----	-----
East of Mississippi River.....	(⁴)	-----	48,114	-----	-----	-----
West of Mississippi River.....	(⁴)	-----	152,353	-----	-----	-----
Total.....	⁵ 438	⁶ 432	142,187,346	145,575,849	24.4	24.7

¹ Included in "Undistributed."² Includes some coal mined in Pennsylvania and cleaned in Ohio and a small tonnage mined in other States and cleaned at a consumer-operated plant in Pennsylvania.³ Includes some coal mined in West Virginia and cleaned in Ohio and Pennsylvania.⁴ See States above.⁵ Represents 52 plants using both wet and pneumatic methods of cleaning and 286 plants using only 1 cleaning method.⁶ Represents 54 plants using both wet and pneumatic methods of cleaning and 378 plants using only 1 cleaning method.

TABLE 40.—*Result of operations at bituminous-coal-cleaning plants in the United States, by States, in net tons, in 1943*

State	Total raw coal moved to cleaning plants	Coal obtained in cleaning process	Refuse resulting in cleaning process	Ratio of refuse to raw coal (percent)	Total production from mines that moved coal to cleaning plants ¹
Alabama.....	15,623,946	13,326,372	2,297,574	14.7	14,583,851
Alaska.....	143,667	100,780	42,887	29.9	162,755
Arkansas.....	43,019	35,638	7,381	17.2	275,055
Colorado.....	125,617	119,048	6,569	5.2	336,589
Illinois.....	26,062,072	30,321,306	5,740,766	15.9	47,545,486
Indiana.....	11,220,906	9,612,008	1,608,898	14.3	14,847,330
Kansas.....	2,322,318	1,845,362	476,956	20.5	2,006,683
Kentucky.....	7,909,866	6,896,774	1,013,092	12.8	11,122,395
Michigan.....	31,612	25,290	6,322	20.0	114,199
Missouri.....	2,942,147	2,334,203	607,944	20.7	3,119,380
Montana.....	155,000	146,503	8,497	5.5	475,925
New Mexico.....	57,122	53,703	3,419	6.0	320,970
Ohio.....	8,445,844	6,611,721	1,834,123	21.7	7,750,638
Oklahoma.....	117,853	108,942	8,911	7.6	108,942
Pennsylvania ²	29,360,134	26,523,666	2,836,468	9.7	39,506,970
Tennessee.....	476,367	438,168	38,199	8.0	1,289,595
Utah.....	889,507	839,111	50,396	5.7	1,719,665
Virginia.....	3,599,175	3,292,751	306,424	8.5	10,883,459
Washington.....	1,569,149	1,347,160	221,989	14.1	1,461,741
West Virginia ³	35,660,590	31,630,159	4,030,431	11.3	64,664,586
Total at mines only ⁴	156,755,911	135,608,665	21,147,246	13.5	222,896,414
Consumer plants ⁵	10,553,898	9,967,184	586,714	5.6	.....
Grand total.....	167,309,809	145,575,849	21,733,960	13.0	.....

¹ Based upon shipping weights and includes some marketable coal that did not pass through cleaning plants.

² Includes some coal mined in Pennsylvania and cleaned in Ohio.

³ Includes some coal mined in West Virginia and cleaned in Ohio and Pennsylvania.

⁴ Includes all mechanical cleaning other than washeries operated by consumer steel companies.

⁵ Includes central washeries in Colorado and Pennsylvania operated by consumer steel companies.

DETAILED STATISTICS, BY STATES AND COUNTIES

Detailed production and employment statistics are given in table 41 for each coal-producing county in the United States from which three or more operators submitted reports for 1943. Statistics on counties with less than three reporting producers have been combined with data for other counties in the same State to avoid disclosing individual figures, unless permission to publish has been granted by the operators. Production of mines on the border between two States has been credited to the State from which the coal was extracted rather than to that in which the tippie was situated. If the coal is mined from lands in both States, the tonnage has been apportioned accordingly.

In this series the reported production is classified according to the principal methods of distribution or use. Beginning with 1932, the series was expanded to include data on the growing volume of coal moving from mine to consumer by truck. For 1933-36 this tonnage was shown as "Commercial sales by truck or wagon." In 1937 this tonnage was shown as "Truck deliveries, including local sales" (see Minerals Yearbook, 1939, p. 813). In 1938 the truck tonnage was shown as "Shipped by truck or wagon." The truck figures for 1933 to 1936, inclusive, and 1938 to 1943, inclusive, are reasonably comparable.

The data in the present report, as in those published for many years by the Bureau of Mines, relate only to mines with an annual output

of 1,000 tons or more. That fact should be borne in mind when the statistics in this report are compared with similar data compiled by State mine departments. Differences arise largely from variations in coverage by State reports, some of which include data for all mines regardless of size, and others only data for mines employing more than a specified minimum number, ranging from 2 to 10 men. To meet the administrative demand for statistics on mines with an annual output of less than 1,000 tons per year, data for the small mines are shown in table 42. The average tons per man per day at the small mines was low due to part-time employment, lack of machinery, and difficult working conditions. The production shown in table 42 is not included in the total output shown in other tables for the United States, as this would upset the comparability of the statistical series.

Because of a change in method of reporting, statistics of average production per man per day for 1932 to 1936 and 1938 to 1941 are not precisely comparable with those for other years. For other years they were based upon the calculated number of man-shifts, obtained by multiplying the average number of men employed at each mine by the number of days worked at the mine. From 1932 to 1936 and 1938 to 1941 the operators were asked to make, if possible, a special report of the number of man-shifts actually worked. The number of operators able to furnish this information was small. These reports were utilized to improve the accuracy of the record. Otherwise, the man-shifts were calculated by multiplying the number employed underground and on the surface by the number of days worked by the mine and tippie, respectively.

TABLE 41.—*Production, value, employment, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1943*
 [Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)				Average value per ton 2	Average number of employees			Average number of days mines were active	Number of man-days worked	Average tons per man per day	
	Loaded for shipment by rail or water 1	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine 1	Used at mine for power and heat or bechive coke at mine		Total quantity	Underground	Surface				
								In strip pits				All others
ALABAMA												
Bibb.....	701,205	34,775	4,505	18,968	849,453	\$3.71	1,006	262	1,268	322,840	2.63	
Blount.....	38,489	73,162	1,163	970	112,784	3.11	150	50	202	49,007	2.30	
Cherokee.....		3,909			3,909	3.34	6	1	7	1,820	2.02	
Cullman.....		36,423	76	15	36,513	3.80	75	15	90	18,657	1.96	
Etowah.....	2,052	22,362			24,414	3.34	27		27	8,360	2.92	
Jackson.....	3,222	29,792	20		33,034	3.48	39	14	53	12,897	2.56	
Jefferson.....	8,486,341	264,968	71,434	28,407	8,841,080	3.66	11,134	1,959	13,113	3,337,120	2.65	
Marion.....	226,318	76,193	1,478		303,989	4.15	437	88	525	128,574	2.36	
St. Clair.....	930,061	42,662	9,536	44,114	1,026,373	3.26	918	235	1,153	292,298	3.51	
Shelby.....	427,892	68,665	2,778	783	500,118	3.87	731	146	877	216,561	2.31	
Tuscaloosa.....	246,833	42,857	4,022		293,712	2.85	357	79	436	112,676	2.61	
Walker.....	4,838,835	244,842	340,672	2,268	5,126,317	3.20	4,388	873	5,461	1,376,021	3.73	
Winston.....	600	8,029	25		8,654	3.01	19	3	22	4,300	2.01	
Total Alabama.....	15,691,648	938,839	434,706	495,625	17,160,320	3.45	19,287	3,720	23,774	5,881,131	2.92	
ALASKA												
Total Alaska.....	268,543	2,777	1,331	416,681	289,232	\$6.37	172	79	251	80,564	3.50	
ARIZONA												
Total Arizona.....		11,166	125		11,281	\$2.63	26	5	31	209	6,491	1.74

See footnotes at end of table.

TABLE 41.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1948—Continued*

[Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)				Average value per ton ²	Average number of employees			Number of man-days worked	Average tons per man per day		
	Loaded for shipment by rail or water ¹	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine ³	Used at mine for power and heat or made into beehive coke at mine ⁴		Underground	Surface				Total	
							In strip pits	All others				
ARKANSAS												
Franklin.....	134,284	2,840	545	1,860	139,529	194	12	38	244	203	49,443	2.82
Johnson.....	312,795	22,295	136	605	335,831	380	32	89	501	200	100,413	3.34
Logan.....	459,240	1,875	3,712	417	465,244	747	---	110	857	223	190,834	2.44
Sebastian.....	731,077	44,732	378	1,144	777,331	926	110	192	1,228	177	216,822	3.59
Total Arkansas.....	1,637,396	71,742	4,771	4,026	1,717,935	2,247	154	429	2,830	197	557,512	3.08
COLORADO												
Boulder.....	274,708	320,010	5,741	4,807	605,266	473	---	87	560	248	139,122	4.35
Delta.....	80,829	27,400	4,458	4,836	113,523	66	---	27	93	272	25,331	4.48
El Paso.....	34,760	174,341	32,654	7,681	249,436	181	---	23	204	270	55,024	4.53
Fremont.....	211,646	349,153	6,791	58	567,648	456	---	113	569	264	149,933	3.79
Garfield.....	15,476	41,792	10	1,080	58,958	46	---	16	62	268	15,979	3.69
Gunnison.....	707,709	20,047	9,089	14,429	751,274	317	---	132	527	287	151,057	4.97
Huerfano.....	1,019,447	62,157	5,615	1,619	1,088,838	806	---	207	1,013	267	270,919	4.02
Jackson.....	6,777	5,103	---	669	12,549	3	11	2	16	144	2,304	5.45
La Plata.....	18,623	36,449	---	36	55,238	49	---	9	68	276	16,022	3.45
Las Animas.....	1,469,405	43,039	9,281	173,428	1,695,153	1,622	---	296	1,918	278	533,666	3.13
Mesa.....	68,904	25,131	7,553	5,600	100,188	103	---	22	125	256	32,003	3.13
Monte.....	57,208	23,108	7,824	88,140	3,092	32	---	13	45	243	10,933	8.06
Poudre.....	1,116,519	21,097	16,436	40,431	1,194,483	701	---	272	973	259	252,661	4.74
Weld.....	1,203,186	267,247	10,347	23,934	1,534,714	910	---	196	1,106	237	261,904	5.87
Other counties: Elbert and Jefferson.....	122,009	34,019	1,025	862	157,915	104	---	24	128	242	31,024	5.09
Montrose and Rio Blanco.....	---	39,554	11,315	---	50,869	43	---	7	50	298	14,900	3.41
Total Colorado.....	6,407,206	1,519,647	117,269	1,280,070	8,324,192	5,990	11	1,446	7,447	263	1,961,782	4.24

GEORGIA

ILLINOIS

Total Georgia.....	13, 632	.....	363	* 390	14, 385	\$3.78	50	.....	10	60	266	14, 960	0.90
Christian.....	6, 596, 685	108, 116	43, 766	35, 950	6, 844, 526	\$1.65	1, 782	.....	480	2, 262	276	624, 031	10.97
Clinton.....	249, 966	117, 692	2, 262	12, 205	382, 125	2.12	298	.....	68	44	231	82, 296	4.64
Edgar.....	32, 020	32, 020	.....	2, 345	34, 365	2.43	.....	.....	4	.....	176	7, 774	4.44
Franklin.....	15, 768, 726	170, 669	194, 847	203, 378	16, 327, 620	2.31	5, 235	.....	1, 547	6, 782	176	1, 845, 724	8.85
Fulton.....	6, 662, 086	427, 027	7, 971	14, 234	7, 111, 318	2.10	3, 381	.....	712	1, 496	255	378, 480	18.79
Gallatin.....	13, 376	33, 458	.....	2, 339	49, 173	2.09	57	.....	387	69	176	12, 084	4.07
Henry.....	573, 982	186, 243	773	2, 462	711, 460	2.33	108	.....	54	268	275	73, 751	9.65
Jackson.....	2, 530, 459	124, 919	9, 551	2, 360	2, 667, 289	1.91	797	.....	106	1, 070	260	278, 222	9.69
Knox.....	719, 457	191, 627	2, 222	2, 852	916, 158	2.32	146	.....	211	305	268	91, 003	10.07
La Salle.....	61, 165	262, 187	17, 962	682	331, 996	3.41	272	.....	60	362	208	75, 989	4.40
Livingston.....	.....	1, 007	15	.....	1, 022	3.56	5	.....	1	6	226	1, 356	1.75
Macon.....	.....	39, 483	820	2, 073	42, 376	3.51	82	.....	8	90	174	15, 060	2.71
Macoupin.....	5, 178, 500	222, 190	30, 771	150, 336	5, 681, 797	1.76	2, 068	.....	452	2, 518	278	696, 857	7.98
Madison.....	1, 248, 699	858, 528	14, 195	73, 286	2, 194, 708	2.10	1, 086	.....	245	1, 331	248	328, 723	6.66
Marshall.....	.....	1, 489	.....	.....	.....	3.27	3	.....	1	.....	130	520	2.80
Menard.....	.....	74, 441	417	2, 945	77, 803	2.65	81	.....	15	96	251	24, 072	3.23
Mercer.....	.....	5, 878	.....	.....	.....	3.70	21	.....	4	25	138	3, 438	1.71
Montgomery.....	832, 869	24, 811	2, 712	53, 300	913, 692	1.71	219	.....	78	287	286	84, 942	10.76
Peoria.....	320, 800	480, 663	3, 931	1, 210	806, 604	2.52	598	.....	71	639	231	147, 309	5.48
Perry.....	4, 118, 403	112, 140	16, 173	54, 135	4, 300, 851	1.98	851	.....	455	1, 755	252	441, 422	9.74
Randolph.....	2, 229, 618	100, 085	3, 804	41, 487	2, 375, 054	1.98	712	.....	300	1, 063	246	261, 975	9.07
Rock Island.....	.....	1, 987	.....	.....	.....	3.27	3	.....	51	3	230	690	2.88
St. Clair.....	1, 495, 617	1, 409, 578	133, 524	66, 673	3, 105, 392	1.99	1, 284	.....	302	1, 683	225	379, 688	8.19
Saline.....	4, 906, 218	174, 039	17, 768	42, 518	5, 040, 553	2.46	1, 507	.....	555	2, 199	254	558, 522	9.02
Sangamon.....	2, 541, 715	713, 360	11, 971	28, 300	3, 295, 346	2.09	2, 096	.....	325	2, 421	238	570, 753	6.71
Schuyler.....	172, 635	65, 772	1, 879	6	240, 252	2.16	27	.....	25	83	273	22, 941	10.14
Stark.....	.....	1, 060	.....	.....	.....	2.91	3	.....	31	3	285	38, 855	1.94
Tazewell.....	.....	128, 370	243	655	129, 268	2.95	116	.....	24	140	256	34, 539	3.61
Vermilion.....	2, 079, 335	377, 452	28, 889	12, 313	2, 497, 989	2.31	1, 584	.....	215	1, 835	259	474, 702	5.36
Wabash.....	.....	1, 068	.....	.....	.....	2.26	.....	.....	1	3	200	1, 001	1.71
Winnington.....	300, 818	63, 398	2, 268	16, 293	473, 105	2.18	225	.....	56	281	246	69, 228	6.53
Williamson.....	2, 883, 011	539, 522	9, 425	54, 870	3, 486, 528	2.28	1, 328	.....	373	1, 725	246	421, 148	8.88
Other counties.....	2, 012, 795	607, 506	12, 143	48, 079	2, 681, 123	2.53	488	.....	346	32, 366	266	308, 300	8.57
Total Illinois.....	63, 576, 935	7, 557, 677	570, 342	* 926, 316	72, 631, 270	2.13	23, 473	.....	1, 745	32, 366	257	8, 329, 034	18.72

See footnotes at end of table.

TABLE 41.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1943—Continued*
 [Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)				Average value per ton ¹	Average number of employees			Average number of days mines were active	Number of man-days worked	Average tons per man per day	
	Loaded for shipment by rail or water ¹	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mines ²	Used at mine for power and heat or made into beehive coke at mine		Total quantity	Surface					Underground
							In strip pits	All others				
INDIANA												
Clay.....	1,573,966	333,599	1,607	6,937	1,916,129	80	296	210	686	156,725	12.23	
Davies.....	14,000	111,911	356	445	126,712	52	24	20	96	23,679	6.35	
Dubois.....	.....	9,082	6	.....	9,088	9	.....	3	12	258	2.98	
Fountain.....	.....	76,466	.....	.....	81,086	.....	23	12	35	7,821	10.86	
Gibson.....	828,499	179,929	208	27,025	1,035,661	487	314	79	696	124,052	8.35	
Greene.....	2,571,144	75,348	836	16,278	2,663,606	2,09	314	343	971	275,358	9.67	
Knox.....	2,986,071	503,682	10,304	25,618	3,525,675	1,402	20	417	1,839	455,087	7.75	
Martin.....	.....	2,996	2,000	10	5,006	8	5	5	18	2,338	2.14	
Owen.....	219,819	1,720	623	2,503	222,162	2,44	51	21	72	13,280	16.73	
Parke.....	.....	62,479	200	2,503	65,182	2,60	.....	12	71	16,125	4.04	
Perry.....	.....	25,354	87	24	25,465	31	.....	7	38	9,118	2.79	
Pike.....	3,855,275	26,515	7,873	17,147	3,905,445	1,86	433	498	943	225,558	17.31	
Spencer.....	33,451	76,515	187	188	110,351	23	37	23	83	14,506	7.61	
Sullivan.....	2,150,748	101,725	4,793	18,823	2,276,089	2,30	122	283	1,508	370,501	6.14	
Vanderburgh.....	37,479	51,385	226	1,519	90,609	1,103	.....	40	1,143	26,169	3.46	
Vermillion.....	379,580	89,408	550	3,345	472,883	2,01	78	101	250	46,571	10.15	
Vigo.....	3,820,235	359,041	463,899	10,610	4,655,755	1,833	193	404	2,430	546,132	8.52	
Warrick.....	3,624,644	247,973	2,978	1,484	3,877,079	1,91	257	366	2,493	262,997	14.74	
Total Indiana.....	22,100,151	2,333,763	498,703	131,966	25,064,583	5,907	1,953	2,844	10,704	2,578,817	19.72	
IOWA												
Adams.....	.....	1,206	.....	.....	1,206	7	.....	1	8	1,048	1.15	
Appanoose.....	304,455	143,947	6,514	413	455,359	823	.....	96	919	166,868	2.74	
Boone.....	96,104	43,097	3,144	1,302	142,647	319	.....	35	354	48,935	2.92	
Guthrie.....	.....	12,601	.....	22	12,623	34	.....	5	39	7,180	1.74	

Asper	51,904	481	8	52,267	3,28	55	11	15	81	171	13,896	3.78
Ark	36,827	1,083		62,942	3.05	60	13	7	31	190	12,670	3.78
Alaska	134,681	553	341	267,042	2.89	377	100	45	70	182	12,185	6.17
Marion	301,709	2,051	2,157	624,846	2.73	377	80	101	558	213	38,752	6.80
Monroe	80,833	2,211	1,393	240,551	2.95	237	4	33	274	225	125,736	4.97
Page	12,606	219	10	12,635	4.09	32		83	37	236	64,929	3.72
Polk	240,049	5,003	1,038	279,503	3.29	428		37	463	209	7,716	1.64
Taylor	5,347			5,347	4.90	15		1	16	166	77,065	3.63
Van Ruren	31,681	262	58	32,001	3.16	18		10	287	287	4,592	1.16
Wapello	164,151	353	2,884	176,132	2.98	152	14	10	412	246	10,320	3.10
Wayne	10,919	220	42	11,181	3.44	27	23	37	212	208	44,168	3.99
Wesler	16,138	380	233	31,931	3.24	36		9	31	166	6,153	2.17
Other counties (Dallas, Greene, and Warren)	111,240	4,051	1,126	360,210	3.21	332		51	45	180	8,100	3.94
Total Iowa	1,312,455	26,325	11,027	2,770,610	3.10	2,998	235	492	3,725	243	93,114	3.87
										196	729,468	3.80

KANSAS

Bourbon	27,902	136	506	201,605	\$2.38		51	16	67	235	15,771	12.78
Cherokee	173,061	2,087	4,487	1,117,221	2.45	14	236	137	387	246	95,331	11.72
Crawford	1,024,535	3,355	6,399	1,499,393	2.51	405	321	192	918	197	180,898	8.29
Franklin	1,382,142			6,483	4.38	13		1	14	215	3,010	2.15
Linn	6,483	50	120	489,103	2.18	15	39	43	97	279	27,096	18.05
Osage	475,307	607		62,540	4.14	180	13	13	206	199	40,934	1.53
Other counties (La Bette and Leavenworth)	18,012	35,264	5,580	60,436	4.55	216	13	88	317	301	95,476	.63
Total Kansas	3,056,625	41,499	17,092	3,436,781	2.50	843	673	490	2,006	229	458,516	\$ 7.50

KENTUCKY

Eastern district:												
Bell	181,169	19,166	4,479	2,967,576	\$2.95	2,799		469	3,268	256	835,844	3.55
Boyd	61,231	7,165		61,231	2.67	95		20	115	240	27,620	2.22
Breathitt	46,121			61,503	2.57	91		16	107	251	26,879	2.22
Carroll	32,057		1,989	143,254	2.63	172		63	235	188	44,222	3.24
Clay	165,995			310,419	2.83	458		84	542	208	112,895	1.87
Clinton	6,205	135		6,340	3.33	11		2	13	261	3,393	1.50
Elliot	2,350			2,350	2.75	4		2	6	261	1,566	1.50
Floyd	19,625	16,765	21,396	6,841,000	3.02	4,986		883	5,869	285	1,551,261	4.41
Greenup	3,600			3,600	2.40	8		2	108	138	3,375	2.62
Harlan	54,317	100,821	9,901	13,340,479	3.06	10,087		1,621	11,708	293	3,143,275	4.24
Jackson	195,330		2,288	197,618	2.63	287		59	740	238	77,652	2.55
Johnson	23,663	4,884	1,679	705,650	3.43	626		114		260	192,693	3.66

See footnotes at end of table.

TABLE 41.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1943—Continued*
 [Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)				Average value per ton	Average number of employees			Average number of days mines were active	Number of man-days worked	Average tons per man per day	
	Loaded for shipment by rail or water	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine	Used at mine for power and heat or made into beehive coke at mine		Total quantity	Underground	Surface				
								In strip pits				All others

KENTUCKY—Continued												
Eastern district—Continued.	453,770	1,200	2,289	—	457,259	\$2.87	403	—	478	207	99,117	4.61
Knox.....	548,551	102,473	4,957	—	655,981	2.60	613	—	769	228	176,340	3.74
Laurel.....	21,941	155,601	4,334	178	178,084	2.72	288	8	324	213	69,103	2.58
Lawrence.....	—	11,870	100	500	12,270	2.17	16	2	18	233	4,194	2.93
Lee.....	11,800	18,734	—	—	30,534	3.00	44	9	53	243	12,876	2.37
Leslie.....	183,505	7,945	—	50	191,510	2.80	179	36	215	276	99,895	3.22
Letcher.....	5,313,940	71,303	32,261	5,867	5,423,421	2.96	3,927	3	4,548	257	1,170,210	4.63
McCreary.....	897,637	24,312	12,421	120	934,490	2.81	901	114	1,012	280	283,808	3.29
Magoffin.....	98,980	4,330	—	—	103,830	2.84	100	—	1,132	239	31,532	3.68
Martin.....	437,060	2,537	515	—	440,112	2.56	196	48	244	264	64,513	6.82
Menifee.....	—	1,800	—	1	1,800	2.38	4	—	5	250	1,250	1.44
Perry.....	6,094,407	30,888	123,074	314	6,248,683	2.90	4,110	788	4,896	271	1,328,668	4.70
Pike.....	7,587,267	334,451	302,646	10,989	8,263,333	2.75	5,447	1,287	6,734	257	1,328,270	4.77
Pulaski.....	2,500	79,777	64	—	82,341	2.85	147	31	178	191	33,967	2.42
Rockcastle.....	—	13,898	—	—	13,898	2.35	23	6	29	256	7,416	1.57
Wayne.....	—	3,056	—	—	3,056	2.35	7	2	9	144	1,300	2.25
Whitley.....	287,889	45,840	1,927	8,790	344,446	2.95	378	80	491	217	106,710	2.25
Wolfe.....	—	7,823	35	—	7,858	2.64	12	1	13	241	3,135	2.51
Other counties (Morgan and Owsley).....	—	8,200	—	—	8,200	3.08	11	3	14	200	2,799	2.93
Total Eastern Kentucky.....	45,542,369	1,772,533	630,674	10,96,540	48,042,116	2.93	36,380	41	6,085	259	11,176,277	4.30

Western district:

Builer.....	31,292	68,680	.....	68,680	2.04	93	.....	18	111	193	21,413	3.21
Christian.....	24,132	55,424	.....	55,424	2.05	27	.....	14	61	178	10,840	5.21
Davies.....	206,854	210,607	357	210,607	1.76	211	.....	66	267	108	63,911	3.96
Edmondson.....	.....	1,686	.....	1,686	2.04	3	.....	.....	3	170	610	2.03
Hancock.....	19,184	19,184	.....	19,184	2.05	30	.....	6	35	201	7,048	2.72
Henderson.....	15,326	140,407	641	159,074	1.65	142	.....	33	175	233	40,733	3.91
Hopkins.....	7,053,635	378,669	40,890	7,482,196	2.03	2,445	281	801	3,527	253	892,264	8.39
McLean.....	.....	26,900	.....	26,900	1.65	16	.....	.....	19	261	4,959	5.42
Muhlenberg.....	4,630,028	263,902	15,085	4,961,496	1.89	2,337	63	529	2,929	265	748,265	6.6
Ohio.....	238,080	126,782	706	239,438	2.01	280	65	76	421	190	70,836	4.59
Union.....	760,988	75,802	.....	850,693	1.92	534	.....	93	627	276	173,036	4.92
Webster.....	936,925	21,962	7,739	966,626	1.96	562	.....	105	667	270	180,146	5.37
Total Western Ken- tucky.....	13,667,874	1,354,977	57,679	15,196,357	1.97	6,680	429	1,733	8,942	250	2,211,980	7 6.86
Total Kentucky.....	59,210,243	3,127,510	688,353	63,211,473	2.70	43,060	470	8,418	51,945	258	13,388,257	4.72

MARYLAND

Allegany.....	826,883	276,725	6,167	1,110,459	\$3.09	945	57	228	1,230	243	298,715	3.72
Garrett.....	744,085	70,983	5,262	822,921	2.89	696	17	127	840	249	217,208	3.79
Total Maryland.....	1,570,968	347,408	11,429	1,933,380	3.01	1,641	74	355	2,070	249	515,923	3.75

MICHIGAN

Total Michigan.....	57,141	98,948	3,113	108,615	\$4.87	240		38	278	257	71,472	2.36
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MISSOURI

Adair.....	41,539	125,743	675	2,376	\$2.68	190		37	227	251	57,061	2.99
Barton.....	221,827	18,724	444	240,995	2.52	38	45	27	110	223	24,521	9.53
Bates.....	744,486	17,145	84	763,369	2.20	13	87	77	177	249	44,101	17.35
Boone.....	35,285	25,858	.....	55,393	2.80	10	26	7	43	227	9,775	5.96
Callaway.....	209,874	209,874	.....	209,874	2.54	69	.....	19	68	287	25,244	8.31
Charlton.....	1,447	1,447	.....	1,447	2.67	8	.....	4	161	80	35,981	1.71
Clay.....	57,480	57,480	1,563	61,538	3.64	141	.....	20	20	223	5,583	1.81
Davies.....	13,558	13,558	.....	13,558	3.28	23	.....	3	30	240	6,669	1.88
Harrison.....	1,802	1,802	140	1,943	3.62	24	.....	3	27	216	38,210	12.93
Henry.....	407,977	86,594	80	494,651	2.32	23	100	45	177	216	28,210	12.93
Johnson.....	264,531	27,254	106	292,391	2.48	23	53	20	77	298	21,735	13.41
Lafayette.....	114,022	68,314	4,365	191,438	2.18	349	.....	49	398	248	68,795	11.94
Linn.....	8,663	51,313	.....	59,976	3.01	113	.....	13	126	238	29,962	2.00

See footnotes at end of table.

TABLE 41.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1943—Continued*
 [Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)				Average value per ton	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day	
	Loaded for shipment by rail or water	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine	Used at mine for power and heat or made into beehive coke at mine		Total quantity	Surface						Total
							Under-ground	In strip pits	All others				

MISSOURI—Continued													
Macon.....	696,322	72,820	562	-----	769,704	\$2.30	101	110	107	318	271	86,072	8.94
Moniteau.....	-----	1,283	-----	-----	1,283	2.83	-----	2	-----	2	295	590	2.17
Putnam.....	-----	36,792	130	-----	36,947	2.95	68	-----	24	92	221	20,326	1.82
Randolph.....	458,858	109,518	440	60	568,876	2.37	187	61	105	353	238	83,034	6.76
Ray.....	15,992	90,088	1,142	19	107,241	3.98	288	-----	37	325	169	52,031	1.96
St. Clair.....	12,219	9,626	37	2,650	24,532	2.37	-----	27	8	35	162	3,653	1.34
Vernon.....	142,375	58,425	410	757	201,967	2.59	7	100	32	139	195	27,121	7.45
Other counties (Clark, Dade, Jasper, Monroe, and Ralls).....	-----	30,695	-----	-----	30,695	3.01	5	31	3	39	289	11,272	2.72
Total Missouri.....	3,125,301	1,154,080	10,142	420,113	4,309,636	2.50	1,590	720	642	2,952	234	690,493	9.624

MONTANA													
Montana bituminous coal:	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Blaine.....	-----	13,127	-----	-----	13,127	\$4.30	14	-----	3	17	300	5,100	2.57
Carbon.....	499,748	41,621	4,204	864	546,437	2.71	201	-----	112	313	245	76,765	1.82
Cascade.....	447,001	41,205	998	-----	489,174	1.87	202	-----	34	236	266	62,831	7.79
Chouteau.....	-----	3,910	20	-----	3,930	3.75	4	-----	1	5	215	1,075	3.66
Musselshell.....	1,079,842	48,064	5,405	3,029	1,136,340	2.46	419	-----	192	611	283	172,926	6.57
Other counties (Fergus and Rosebud).....	2,572,575	3,011	4,072	-----	2,579,658	1.18	4	85	24	113	310	35,079	73.54
Total bituminous coal.....	4,599,166	150,938	14,669	3,893	4,768,666	1.74	844	85	366	1,295	273	353,776	713.48
Montana lignite.....	-----	64,198	11,185	(1)	64,383	2.16	46	6	14	66	182	12,038	5.35
Total Montana.....	4,599,166	215,136	11,484	4,893	4,833,049	1.75	890	91	380	1,361	269	365,814	713.21

NEW MEXICO

Cofax.....	1, 101, 655	10, 429	5, 132	3, 256	1, 120, 474	\$3. 26	655	181	836	291	242, 881	4. 91
McKinley.....	492, 030	55, 175	3, 018	29, 440	520, 263	3. 07	612	254	800	270	241, 225	2. 40
Rio Arriba.....	18, 988	2, 580	50	21, 519	21, 519	3. 07	72	8	30	237	7, 110	3. 03
Sandoval.....	3, 488	3, 488	---	---	5, 488	4. 00	10	4	14	204	2, 650	1. 92
San Juan.....	5, 033	5, 033	---	---	5, 033	3. 58	13	3	16	140	2, 388	2. 11
Other counties (Bernalillo, Santa Fe, and Socorro).....	81, 060	31, 986	70	4, 935	118, 051	4. 05	165	76	241	305	73, 388	1. 61
Total New Mexico.....	1, 693, 633	110, 691	8, 870	437, 633	1, 850, 827	3. 53	1, 477	526	2, 003	285	570, 148	3. 25

NORTH DAKOTA (LIGNITE)

Total North Dakota.....	1, 899, 369	516, 778	11 56, 315	4 27, 740	2, 500, 202	\$1. 50	405	324	273	1, 002	223	223, 777	111. 17
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OHIO

Athens.....	2, 068, 839	101, 199	7, 809	10, 013	2, 207, 860	\$2. 63	1, 397	30	421	1, 848	247	456, 865	4. 83
Belmont.....	8, 510, 677	407, 832	31, 566	26, 838	8, 976, 913	2. 45	4, 767	133	1, 048	5, 948	270	1, 008, 810	6. 69
Carroll.....	328, 350	272, 149	2, 537	70	603, 106	2. 54	250	83	63	398	254	100, 399	6. 00
Columbiana.....	123, 754	817, 347	1, 019	239	942, 359	2. 43	183	253	117	553	210	119, 641	7. 88
Coshocton.....	26, 032	309, 177	7, 747	1, 713	337, 669	2. 65	283	18	45	326	232	75, 654	4. 46
Gallia.....	40, 153	88, 414	684	---	129, 251	2. 69	130	12	27	169	256	43, 265	2. 69
Guernsey.....	559, 805	107, 950	2, 200	608	670, 563	2. 22	489	464	60	549	248	136, 147	4. 93
Harrison.....	5, 902, 136	77, 247	3, 988	16, 396	6, 006, 767	2. 35	1, 127	464	625	2, 216	261	685, 877	10. 25
Hocking.....	278, 767	114, 081	727	13	393, 588	2. 65	352	44	44	398	246	97, 897	4. 03
Holmes.....	99, 199	20, 950	430	---	20, 958	2. 97	8	12	10	30	165	4, 946	4. 24
Jackson.....	6, 000, 766	118, 383	27, 430	7, 865	245, 012	2. 93	210	26	46	282	262	73, 958	3. 31
Jefferson.....	62, 306	41, 470	1, 671	111	42, 486	2. 16	69	98	15	84	206	815, 096	6. 96
Lawrence.....	261, 706	104, 010	1, 357	2, 524	282, 759	2. 57	348	---	24	416	211	17, 313	2. 45
Mahoning.....	1, 429, 769	238, 751	7, 892	366, 073	2, 524	2. 57	208	---	68	416	237	30, 027	9. 42
Meigs.....	256, 862	10, 749	50	---	267, 661	2. 49	184	---	36	220	273	98, 515	3. 72
Morgan.....	1, 447	238, 751	1, 447	437	1, 670, 404	2. 05	727	24	171	922	259	60, 169	4. 46
Muskingum.....	123, 356	2, 457	7, 892	15	133, 710	2. 36	108	15	25	148	227	236, 192	6. 86
Noble.....	782, 141	250, 449	2, 697	376	1, 035, 663	2. 49	651	78	207	936	222	33, 642	3. 99
Perry.....	98, 902	448, 167	45	340	448, 552	2. 57	52	16	6	35	234	6, 183	4. 90
Portage.....	124, 696	1, 040, 040	3, 705	223	1, 568, 664	2. 50	691	117	45	214	286	61, 112	7. 44
Stark.....	73, 678	1, 440, 400	152	520	1, 117, 833	2. 32	51	192	172	1, 055	232	244, 791	9. 41
Tuscarawas.....	43, 483	1, 117, 833	152	520	1, 117, 833	2. 51	51	40	25	1, 116	236	27, 376	4. 30
Vinton.....	---	---	---	---	---	2. 71	2	---	1	3	250	750	1. 63
Washington.....	---	---	---	---	---	---	---	---	---	---	---	---	---
Total Ohio.....	26, 050, 772	6, 026, 545	106, 375	4 68, 301	32, 254, 943	2. 42	14, 206	1, 974	4, 042	20, 222	254	5, 144, 929	6. 27

See footnotes at end of table.

TABLE 41.—*Production, value, employment, days active, man-days, and output per man, per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1943—Continued*
 [Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)					Average value per ton ¹	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water ¹	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine ¹	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Under-ground	Surface		Total			
								In strip pits	All others				

OKLAHOMA													
Coal.....	33,738	29,035	255	7	63,035	\$4.17	32	53	14	99	151	14,977	4.22
Crater.....	17,063	2,072	50	600	17,718	3.51	15	15	1	16	296	4,740	3.74
Lawton.....	1,196	1,196	—	771	102,060	3.09	102	30	66	201	296	57,493	1.78
LeFlore.....	3,113	3,113	—	—	17,057	2.90	30	—	9	39	123	4,785	3.56
Nowata.....	1,000	1,000	—	2,872	396,521	4.33	569	—	151	740	222	164,559	2.41
Okfuskee.....	33,987	33,987	—	—	123,891	2.89	10	32	19	61	236	14,384	8.61
Ottawa.....	603,826	6,527	72	1,745	639,630	3.00	448	—	60	508	271	137,441	4.65
Pittsburg.....	234,360	4,984	1,110	4,984	246,981	4.25	402	—	170	572	280	159,914	1.54
Rogers.....	436,557	31,877	5,983	7,197	481,594	2.64	—	99	65	164	268	43,986	10.95
Tulsa.....	4,128	16,941	189	20	21,278	3.51	37	—	9	46	286	13,156	1.62
Other counties (McIntosh and Wagoner).....	702,710	24,857	15	—	727,592	2.57	—	89	65	154	283	43,932	16.69
Total Oklahoma.....	2,643,316	167,673	8,162	18,196	2,837,347	3.16	1,650	318	632	2,600 ^a	253	658,967	4.31

OREGON													
Total Oregon.....	50	1,150	—	—	1,200	\$4.00	5	—	1	6	140	840	1.43

PENNSYLVANIA (BITUMINOUS COAL)

Allegheny.....	13,703,062	2,061,016	1,205,903	5,217	17,724,858	92.66	8,878	555	1,450	10,892	271	2,984,405	5.94
Armstrong.....	5,541,214	262,118	50,504	1,362	5,855,298	2.44	3,136	248	591	4,276	263	1,080,534	6.42
Beaver.....	23,187	359,992	30,327	1,483	412,619	2.76	492	77	60	682	263	72,502	5.90
Bedford.....	307,649	103,737	204,164	13 45,053	131,025	3.16	152	-----	26	178	258	176,024	3.71
Blair.....	36,122	83,979	924	-----	121,025	3.16	152	-----	26	178	251	44,708	2.71
Bradford.....	-----	4,890	-----	-----	4,890	3.50	-----	-----	3	8	264	2,112	2.31
Butler.....	631,478	579,024	14,433	2,179	1,227,114	2.86	789	188	170	1,147	242	278,076	170
Cambria.....	16,670,492	703,855	1,898,535	11 262,171	19,534,963	8.12	14,137	304	2,761	17,202	267	4,615,619	4.23
Centre.....	994,367	246,057	1,136	314	1,311,894	2.79	1,789	112	333	1,034	263	273,210	4.23
Clarion.....	3,248,596	409,632	36,800	83	3,663,111	2.61	1,332	510	319	1,991	252	483,502	9.49
Clelland.....	5,321,223	483,194	17,446	30,818	5,804,611	2.91	3,282	675	837	4,704	236	1,220,138	4.76
Columbia.....	328,170	92,067	28	-----	328,170	2.81	75	105	54	234	280	65,421	9.62
Elk.....	555,317	135,238	2,878	19,778	713,263	2.80	517	477	165	694	278	180,008	3.76
Fayette.....	15,991,732	2,314,204	208,164	13 4,842,773	23,334,863	2.89	15,657	44	2,477	18,611	267	4,981,100	4.71
Greene.....	6,994,911	41,136	18,104	15,718	7,070,863	2.66	4,130	66	810	4,984	278	1,383,180	5.11
Huntingdon.....	313,401	100,583	3,818	15,708	329,603	3.25	4,422	44	66	4,984	262	1,337,444	3.07
Indiana.....	8,276,063	430,691	345,112	13 416,845	9,468,791	2.71	5,455	231	1,053	6,713	269	1,802,471	5.25
Jefferson.....	2,083,322	347,800	3,323	4,889	2,439,391	2.78	1,551	231	365	2,147	242	518,504	4.70
Lawrence.....	-----	12,405	21	19	12,426	2.48	32	63	14	99	197	19,522	9.84
Lycoming.....	-----	41,359	41	19	41,544	3.01	48	6	68	68	254	17,252	3.07
Mercer.....	112,123	322,272	731	-----	435,226	2.90	160	88	44	292	205	59,782	9.28
Somerset.....	6,808,317	243,112	19,701	49,978	7,119,598	2.90	4,761	260	994	6,021	263	1,583,729	4.50
Toga.....	253,238	163,103	315	537	399,573	3.25	213	48	65	326	249	81,096	3.82
Venango.....	17,131	57,131	-----	-----	58,262	2.36	18	16	10	44	193	8,494	9.86
Washington.....	19,089,075	610,992	292,231	20,638	20,018,906	2.74	11,662	700	1,896	14,278	270	3,853,113	5.20
Westmoreland.....	9,017,850	1,897,120	231,486	13 1,638,365	12,504,821	2.71	6,539	481	1,234	8,244	263	2,170,725	5.76
Other counties (Cameron, Forest, Fulton, and Mc Kean).....	235,611	10,422	98	30	246,161	3.23	155	22	33	210	277	58,217	4.23
Total Pennsylvania.....	118,388,171	12,548,264	4,734,667	13 7,380,712	141,049,814	2.82	84,600	5,503	15,713	105,816	266	28,168,796	5.01

SOUTH DAKOTA (LIGNITE)

Total South Dakota.....	(1)	11 40,589	11 75	(11)	40,664	\$1.92	4	21	4	29	203	5,890	6.90
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See footnotes at end of table.

TABLE 41.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1943—Continued*

[Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)				Average value per ton	Average number of employees			Number of man-days worked	Average tons per man per day	
	Loaded for shipment by rail or water	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at mine, or other uses at mine	Used at mine for power and heat or made into beehive coke at mine		Total quantity	Surface				Average number of days mines were active
							Under-ground	All others			
TENNESSEE											
Anderson.....	1,254,823	7,844	11,186	115	1,273,768	\$2.77	1,031	138	1,169	274,059	4.65
Bledsoe.....	68,914	5,643	29,639	64	1,73,280	2.66	95	18	113	24,630	2.98
Campbell.....	1,743,812	44,096	17,334	3,377	1,817,080	3.06	1,651	313	1,964	476,440	3.81
Calhoun.....	1,724,240	38,730	17,334	3,377	1,784,680	2.73	1,427	246	1,673	438,829	4.06
Cumberland.....	13,789	19,165	90	1,065	34,109	2.08	55	11	66	15,374	2.22
DeKalb.....	288,783	28,337	3,006	3,006	323,456	2.60	226	15	295	65,707	4.92
Grundy.....	547,708	1,517	8,765	13,344	665,394	2.93	616	64	667	141,651	3.96
Hamilton.....	47,484	15,240	5,443	1,319	65,030	2.86	112	23	135	23,098	2.87
Marion.....	556,901	95,989	5,443	9,433	659,632	2.98	818	177	995	230,750	2.86
Morgan.....	73,211	14,884	8,275	9,433	98,649	1.84	136	23	159	43,900	2.90
Overton.....	157,524	1,645	8,275	227	167,672	2.54	187	30	217	57,721	3.01
Sevier.....	122,342	6,835	45	45	129,342	2.82	214	34	248	43,017	3.18
Sevier.....	62,303	78,625	476	446	139,750	2.80	183	23	206	43,982	3.18
Sevier.....	62,303	11,763	12	40	11,845	2.42	20	7	27	5,307	2.23
Other counties: (Rhea and Van Buren).....	-----	34,301	20	-----	34,321	2.91	80	12	92	15,707	2.19
Total Tennessee.....	6,659,203	407,711	85,523	12,263,481	7,178,918	2.83	6,761	1,100	7,926	1,898,082	3.78
TEXAS											
Texas bituminous coal.....	7,562	1,535	-----	-----	9,097	\$4.32	21	5	26	6,500	1.40
Texas lignite.....	140,826	(u)	11 3,318	(u)	144,144	.88	44	14	68	8,762	16.45
Total Texas.....	148,388	1,535	3,318	-----	153,241	1.09	65	14	94	15,262	10.04

UTAH

Carbon.....	4,686,219	147,000	37,441	4,011,492	83.00	1,920	792	2,711	295	800,698	6.13
Emery.....	1,488,519	118,402	7,359	1,623,053	2.99	1,901	239	839	298	250,100	6.40
Iron.....	7,701	7,701	103	7,701	4.45	7	8	8	288	2,308	3.34
Silver.....	19,151	19,151	103	19,258	2.43	19	6	25	121	3,020	6.38
Other counties (Garfield, Grand, Summit, and Un- tab.).....	20,506	705	705	104,362	2.73	63	21	84	296	22,345	4.67
Total Utah.....	6,237,829	312,760	45,670	6,965,936	3.00	2,619	1,048	3,037	294	1,078,408	16 6.18

VIRGINIA

Buchanan.....	5,937,101	13,661	14,383	5,966,647	\$2.98	3,591	775	4,366	274	1,196,104	4.99
Dickenson.....	1,989,252	7,937	11,617	2,009,678	2.80	1,535	207	1,742	268	519,881	3.87
Lee.....	1,270,307	61,285	14,088	1,317,315	3.11	1,189	127	1,361	266	307,622	3.66
Russell.....	1,170,809	84,809	11,542	1,382	2.79	934	131	1,061	294	312,288	4.06
Tazewell.....	4,710,716	6,959	43,830	4,800,310	3.17	3,830	732	4,552	282	1,281,744	3.74
Wise.....	4,037,572	87,815	29,426	4,056,349	2.76	3,915	621	4,536	266	1,205,551	3.86
Other counties (Montgomery and Scott).....	188,660	38,040	4,131	231,381	3.05	237	66	303	252	76,304	3.03
Total Virginia.....	19,334,194	300,506	129,037	20,280,209	2.95	15,221	2,721	17,942	277	4,961,494	4.09

WASHINGTON

King.....	161,305	330,604	3,027	69	498,035	\$5.01	425	128	565	278	156,849	3.18
Kittitas.....	622,222	41,875	42,712	10,822	717,631	4.06	531	215	755	291	219,754	3.27
Lewis.....	6,867	44,260	103	240	51,520	3.83	49	9	58	256	14,867	3.47
Pierce.....	16,286	14,287	266	79	30,918	4.81	67	20	87	202	17,562	1.76
Thurston.....	36,361	27,910	501	501	64,772	4.03	40	11	51	289	14,760	4.39
Whatcom.....	121,905	37,939	1,132	3,692	164,668	4.34	114	33	147	283	41,663	3.95
Total Washington.....	967,936	496,875	47,801	14,932	1,527,544	4.41	1,226	416	1,663	280	465,455	3.28

WEST VIRGINIA

Barbour.....	2,080,795	34,813	4,516	42	2,130,106	\$2.26	1,198	224	1,564	224	306,033	5.82
Boone.....	3,128,055	8,804	37,625	708	5,174,042	2.79	2,794	634	3,428	275	944,227	5.48
Braxton.....	18,635	10,310	35	300	21,531	2.39	39	7	46	232	10,664	2.77
Brooke.....	941,049	415,952	1,074,811	68	2,431,910	2.22	882	201	1,271	254	323,282	7.52
Clay.....	907,169	18,522	12,444	27,722	996,093	2.74	534	164	698	298	208,230	4.64
Fayette.....	13,107,197	38,876	419,250	341,978	13,907,301	3.06	9,430	1,753	11,391	277	3,158,972	4.40

See footnotes at end of table.

TABLE 41.—*Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1943—Continued*
 [Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)			Average value per ton	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day		
	Loaded for shipment by rail or water	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders, or other uses at mine		Used at mine for power and heat or made into beehive coke at mine	Total quantity	Surface						
							Underground	In strip pits				All others	
								Total					
WEST VIRGINIA—Continued													
Elmer.....	34,091	6,927	316	6	41,343	79	8	87	178	15,453	2.68		
Grant.....	58,540	59,332	95	465	59,100	92	18	110	265	29,153	2.03		
Greenbrier.....	2,540,644	121,296	13,334	1,064	2,613,543	1,570	241	1,887	275	619,780	5.03		
Hancock.....	1,437	100,120	46	88	123,853	4	30	44	252	11,071	11.19		
Harrison.....	8,911,295	112,111	71,384	8,033	9,082,887	2,848	935	4,587	234	1,074,327	78.45		
Kanawha.....	8,530,150	18,086	53,740	8,033	8,704,034	5,438	1,004	6,442	288	1,852,552	4.70		
Lewis.....	2,988	2,988	294	.....	18,980	21	3	24	284	6,821	2.78		
Lincoln.....	22,912,302	13,758	119,390	32,500	23,077,710	9,921	2,253	12,174	227	3,424,248	2.20		
Logan.....	25,799,409	62,151	301,856	39,382	26,256,798	15,740	16	15,740	281	3,424,248	10.67		
McDowell.....	11,027,792	106,270	383,505	38,347	11,555,914	5,559	1,109	6,754	277	1,871,048	4.83		
Marion.....	11,698,653	125,496	184,751	4,439	1,013,329	601	97	710	285	202,100	6.01		
Marshall.....	82,103	72,855	806	.....	155,764	107	27	134	237	31,708	6.01		
Mason.....	3,179,139	15,828	31,773	592	3,227,332	236	661	2,897	279	806,905	4.90		
Meigs.....	134,903	31,044	127	.....	166,074	219	39	258	234	60,254	4.00		
Mineral.....	5,195,729	20,549	37,748	861	5,254,887	3,070	578	3,672	279	1,025,189	5.13		
Mingo.....	11,096,239	153,781	14,790	11,63,901	11,298,711	4,221	1,104	5,400	267	1,442,508	7.83		
Monongalia.....	1,444,569	26,812	4,707	11,29,118	505,206	430	78	508	222	112,672	4.48		
Nicholas.....	1,502,449	303,281	8,533	.....	1,814,263	1,264	190	1,462	278	374,357	4.85		
Ohio.....	1,516,554	38,593	144,007	11,165,558	1,864,712	1,163	290	1,551	271	421,006	4.43		
Preston.....	38,176	6,027	652	20	45,484	133	15	148	75	11,092	4.10		
Putnam.....	15,951,175	45,121	137,497	51,053	16,184,846	10,377	2,157	12,597	279	3,509,921	4.61		
Raleigh.....	1,599,739	81,666	8,606	11,20,801	1,710,812	1,087	1,463	12,597	279	3,509,921	4.44		
Randolph.....	1,058,663	61,907	2,408	5,075	1,128,053	557	104	716	242	173,037	16.52		
Taylor.....	645,591	4,189	4,355	25,665	679,800	483	63	546	287	186,719	4.34		
Tucker.....	405,123	26,891	682	3,924	436,620	232	67	309	276	85,302	5.12		
Upshur.....	261,681	12,064	2,514	.....	276,894	208	44	252	270	68,062	4.71		
Wayne.....	1,583,932	3,498	2,514	5,088	1,595,002	1,058	233	1,291	282	338,756	4.71		
Webster.....	5,200,375	10,611	37,143	22,293	5,270,422	3,072	601	3,673	282	1,037,527	5.08		
Wyoming.....	152,516,744	2,220,619	3,113,913	11,943,033	158,804,309	86,673	18,628	107,264	275	29,497,742	5.38		
Total West Virginia.....													

WYOMING

Carbon.....	1, 144, 941	17, 303	3, 506	27, 576	1, 193, 416	42, 27	267	58	108	433	317	137, 166	8, 70
Converse.....	.....	10, 760	.....	100	16, 893	2, 29	8	.....	2	14	223	3, 120	5, 40
Fremont.....	.....	9, 100	65	.....	9, 165	3, 29	10	.....	6	14	219	3, 498	2, 62
Hot Springs.....	143, 041	28, 395	94	2, 090	173, 599	3, 79	120	.....	36	165	260	42, 893	4, 04
Johnson.....	.....	10, 904	85	159	11, 148	2, 42	10	.....	4	14	249	3, 621	3, 08
Lincoln.....	597, 533	15, 446	3, 224	419	616, 622	2, 86	268	.....	81	379	285	107, 941	5, 71
Lincoln.....	.....	1, 480	.....	.....	1, 480	3, 13	2	.....	.....	2	309	107, 941	2, 89
N Sheridan.....	.....	32, 241	2, 229	1, 189	961, 802	2, 12	230	.....	79	309	229	70, 734	13, 60
Sweetwater.....	5, 898, 135	6, 436	29, 833	58, 027	5, 992, 451	2, 38	2, 468	.....	677	3, 065	331	1, 015, 989	5, 90
Other counties (Campbell and Uinta).....	137, 214	32, 007	632	8, 727	178, 580	1, 77	10	30	33	73	170	12, 434	14, 36
Total Wyoming.....	8, 646, 907	170, 172	39, 778	98, 266	9, 155, 123	2, 38	3, 447	97	926	4, 470	313	1, 397, 757	8, 55

UNITED STATES

Total United States.....	526, 051, 674	42, 432, 667	10, 805, 646	10, 887, 082	590, 177, 069	\$2, 69	326, 763	16, 643	72, 601	416, 007	264	109, 798, 871	5, 38
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Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding for shipment by rail, and bailed by truck to waterway for shipment by water.

Includes coal transported from mine to point of use by conveyor or tram.

Value received or charged for coal, f. o. b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked (not coke) as estimated by producer at average prices that might have been received if such coal had been sold commercially.)

No coal was "Made into beehive coke at mine."

Includes 153,762 tons "Made into beehive coke at mine" in Las Animas County.

"Other counties" in Illinois include Bureau, Grundy, Jefferson, Logan, Marion, Warren, Will, and Woodford.

Output obtained chiefly from strip pits and by use of mechanical loading devices, in which types of operations production per man per day is large.

Production of Alston Coal Co. (Alston mine) and Hume-Sinclair Coal Mining Co. (No. 3 and part of No. 1 mine) credited to Missouri; production of Hume-Sinclair Coal Mining Co. (part of No. 1 mine) credited to Kansas.

Output obtained chiefly from strip pits in which production per man per day is large.

Includes 34,024 tons "Made into beehive coke at mine" in Pike County, Ky.

In Montana and South Dakota some lignite "Used at mine for power and heat" included with "Used by employees." In North Dakota some lignite made into briquets included in "Other uses at mine." In South Dakota some lignite "Loaded for shipment" included in "Shipped by truck or wagon."

Includes coal "Made into beehive coke at mine" in the following counties in Pennsylvania: Bedford, 43,100 tons; Cambria, 77,170; Fayette, 4,806,928; Indiana, 320,867; and Westmoreland, 1,629,795—Grand total, 6,879,860 tons.

Includes 6,479 tons "Made into beehive coke at mine" in Grundy County.

In Texas some lignite "Shipped by truck or wagon" and "Used at mine for power and heat" included in "Other uses at mine."

Includes 31,839 tons "Made into beehive coke at mine" in Carbon County.

Output obtained chiefly by use of mechanical loading devices in which type of operation production per man per day is large.

Includes 495,430 tons "Made into beehive coke at mine" in Wise County.

Includes coal "Made into beehive coke at mine" in following counties in West Virginia: Fayette, 327,355 tons; Monongalia, 63,536; Nicholas, 28,840; Preston, 161,368; and Randolph, 2,741—Grand total, 683,840 tons.

SUMMARY OF SMALL MINES

TABLE 42.—Summary of data on mines in the United States producing less than 1,000 tons a year, by States and districts, in 1943¹

[Figures compiled from schedules actually received and supplemented by State mine inspectors' reports where available. Not possible to obtain complete coverage. Data shown in table not included in other parts of this report]

State or district	Number of active mines	Total production (net tons)	Average value per ton	Average number of employees	Average number of days mines were active	Number of man-days worked	Average tons per man per day
STATES							
Alabama.....	53	19,259	\$2.94	149	86	12,743	1.51
Arkansas.....	50	15,819	4.28	181	60	10,948	1.44
Colorado.....	61	25,199	3.29	127	131	16,682	1.51
Georgia.....	1	604	3.10	24	68	1,640	.37
Idaho.....	1	443	4.33	3	154	462	.96
Illinois.....	126	44,264	2.64	343	77	26,274	1.68
Indiana.....	64	25,727	2.70	152	82	12,506	2.06
Iowa.....	85	34,605	3.25	270	79	21,204	1.63
Kansas.....	22	7,712	3.38	67	68	4,556	1.69
Kentucky.....	549	230,467	2.57	1,466	102	150,226	1.53
Maryland.....	54	21,172	2.64	112	89	9,980	2.12
Missouri.....	100	33,853	3.04	274	93	25,365	1.33
Montana.....	40	13,320	3.47	69	114	7,864	1.69
New Mexico.....	24	11,768	3.79	64	107	6,827	1.72
Ohio.....	382	144,380	2.64	818	92	74,954	1.93
Oklahoma.....	56	22,063	4.24	200	79	15,843	1.39
Oregon.....	2	1,324	5.34	8	177	1,416	.94
Pennsylvania.....	394	169,887	2.64	890	91	81,084	2.10
Tennessee.....	42	12,589	2.64	128	76	9,710	1.30
Texas.....	1	950	4.74	6	100	600	1.58
Utah.....	16	5,888	3.34	40	72	2,869	2.05
Virginia.....	28	10,263	2.74	72	99	7,131	1.44
Washington.....	18	7,298	4.34	61	76	4,614	1.58
West Virginia.....	321	113,720	2.43	725	76	55,280	2.06
Wyoming.....	27	8,349	3.45	54	101	5,470	1.53
Other States ²	3	1,569	4.69	15	99	1,479	1.06
Total.....	2,520	982,492	2.79	6,318	90	567,727	1.73
PRODUCING DISTRICTS³							
District 1. Eastern Pennsylvania.....	311	134,774	\$2.67	640	98	62,842	2.14
District 2. Western Pennsylvania.....	153	61,001	2.55	395	76	30,120	2.03
District 3. Northern West Virginia.....	137	55,847	2.13	317	74	23,583	2.37
District 4. Ohio.....	382	144,380	2.64	818	92	74,954	1.93
District 5. Michigan.....	12	1,797	3.25	22	102	2,243	.80
District 6. Panhandle.....	36	13,536	2.61	81	72	5,795	2.34
District 7. Southern numbered 1.....	626	246,778	2.67	1,653	99	164,088	1.50
District 8. Southern numbered 2.....	95	38,048	2.14	234	89	20,874	1.82
District 9. West Kentucky.....	126	44,264	2.64	343	77	26,274	1.68
District 10. Illinois.....	64	25,727	2.70	152	82	12,506	2.06
District 11. Indiana.....	85	34,605	3.25	270	79	21,204	1.63
District 12. Iowa.....	72	26,180	2.86	224	81	18,249	1.43
District 13. Southeastern.....	64	21,033	4.29	229	65	14,981	1.40
District 14. Arkansas-Oklahoma.....	165	59,364	3.45	499	85	42,331	1.40
District 15. Southwestern.....	4	1,692	2.15	8	186	1,496	1.14
District 16. Northern Colorado.....	63	27,267	3.51	135	128	17,273	1.58
District 17. Southern Colorado.....	21	9,577	3.70	63	99	6,229	1.54
District 18. New Mexico ⁴	28	8,792	3.49	57	104	5,932	1.48
District 19. Wyoming.....	16	5,888	3.34	40	72	2,869	2.05
District 20. Utah.....	40	13,320	3.47	69	114	7,864	1.69
District 21. Montana.....	20	8,622	4.49	69	87	6,030	1.43
District 22. Washington and Oregon ⁴							
Total.....	2,520	982,492	2.79	6,318	90	567,727	1.73

¹ Data on small lignite mines in Montana, North Dakota, South Dakota, and Texas not available.

² Includes Alaska, Arizona, and California.

³ For boundaries of districts, see Bituminous Coal Act of 1937 and modifications thereto.

⁴ For purposes of concealment of individual operators' figures, Alaska (district 23) included with district 18.

STATISTICS ON LIGNITE IN 1943⁴

PRODUCTION

Statistics on the lignite industry in the United States were compiled by the Anthracite and Coke Section of the Bureau of Mines from annual reports received from producers of lignite in the areas mapped

⁴ Compiled by J. A. Corgan and M. I. Cooke.

as lignite in Geological Survey Professional Paper 100-A, *The Coal Fields of the United States*. Subbituminous coal, sometimes called black lignite, is not included in these statistics.

The production of lignite in 1943 totaled 2,749,393 tons, exclusive of some small mines that produced less than 1,000 tons. This is a decrease of 6.2 percent from the 2,930,661 tons produced in 1942. The average value per ton was \$1.49 compared with \$1.36 in 1942. Employees totaled 1,165 in 1943 and 1,490 in 1942, the average output per man per day, based upon calculated man-days was 10.98 and 9.84 tons, respectively, for the same periods. The output per man per day is high in the lignite industry compared with other coal mining in the United States because a large part of the total production—70 percent in 1943—is recovered from strip pits where the average output per man per day is much higher than in deep mining.

In 1943, as for many years, North Dakota was the chief producer of lignite, followed in order by Texas, Montana, and South Dakota. The North Dakota output comprised 91 percent of the total, that of Texas 5 percent, and the output of South Dakota and Montana together, 4 percent.

According to the Federal Power Commission, 586,204 tons of lignite were consumed in the West North Central States for generating electric energy in 1943; 20,187 tons, in the West South Central States; and 418,732 tons—a large part of which was subbituminous—in the Mountain States.

The following tables contain detailed statistics for lignite in 1943. Statistics of the lignite industry in 1944 were not available for publication in this chapter but may be obtained in mimeographed form upon request to the Anthracite and Coke Section, Coal Economics Division, Bureau of Mines.

TABLE 43.—*Summary of production, value, men employed, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1943, by States*

	Montana ¹	North Dakota	South Dakota	Texas	Total
Production (net tons):					
Loaded at mines for shipment.....		1,899,369	(?)	140,826	2,040,195
Commercial sales by truck or wagon.....	64,198	516,778	240,589	3,318	624,883
Used by employees, taken by locomotives at tippie, and other uses.....	185	56,315	475	(?)	58,575
Used at mines for power and heat.....	(⁴)	27,740	(⁴)	(⁴)	27,740
Total production: 1943.....	64,383	2,500,202	40,664	144,144	2,749,393
Value: 1942.....	49,138	2,537,016	53,538	290,969	2,930,661
Total: 1943.....	\$139,000	\$3,752,000	\$78,000	\$127,000	\$4,096,000
1942.....	\$93,000	\$3,551,000	\$104,000	\$246,000	\$3,997,000
Average per ton: 1943.....	\$2.16	\$1.50	\$1.92	\$0.88	\$1.49
1942.....	\$1.89	\$1.40	\$1.94	\$0.85	\$1.36
Number of employees:					
Underground.....	46	405	4	44	499
Surface (including strip pits).....	20	597	25	24	666
Total employees: 1943.....	66	1,002	29	68	1,165
1942.....	82	1,184	51	173	1,490
Average number of days mines operated:					
1943.....	182	223	203	129	215
1942.....	143	205	198	194	200
Man-days of labor: 1943 ⁵.....	12,038	223,777	5,890	8,762	250,467
Average output (tons) per man per day: 1943 ⁶.....	5.36	11.17	6.90	16.45	10.98

¹ Includes output of Custer, Dawson, McCone, Richland, Roosevelt, Sheridan, and Valley Counties.

² Some "Loaded at mines for shipment" included in "Commercial sales by truck or wagon."

³ Some "Other uses" and colliery fuel included in "Commercial sales by truck or wagon."

⁴ Some colliery fuel included in "Other uses."

⁵ Includes some lignite made into briquets.

⁶ Based upon calculated man-days.

TABLE 44.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1943, by States and counties*

MONTANA							
County	Total production (net tons)	Value		Total number of employees	Man-days of labor ¹	Average number of days mine operated	Average tons per man per day ¹
		Total (thousand dollars)	Average per ton				
Custer, Dawson and Valley.....	23,780	51	\$2.14	25	4,156	166	5.72
McCone, Richland, and Roosevelt.....	20,423	46	2.26	20	4,260	213	4.79
Sheridan.....	20,180	42	2.08	21	3,622	172	5.57
Total Montana.....	64,383	139	2.16	66	12,038	182	5.36
NORTH DAKOTA							
Adams.....	75,401	139	\$1.84	54	8,980	166	8.40
Billings and Bowman.....	12,120	31	2.56	14	2,717	194	4.46
Burke.....	375,450	569	1.62	74	16,056	217	23.38
Burleigh.....	330,652	447	1.35	92	21,702	236	15.23
Divide and Golden Valley.....	240,562	343	1.43	58	10,300	178	23.36
Dunn.....	7,171	15	2.09	16	1,401	88	5.12
Grant.....	15,848	35	2.21	22	2,846	129	5.57
Hettinger.....	15,754	35	2.22	21	3,555	169	4.43
McKenzie.....	3,124	8	2.56	9	783	87	3.99
McLean.....	35,689	78	2.19	61	14,721	241	2.42
Mercer.....	552,780	782	1.41	188	48,195	256	11.47
Morton and Mountrail.....	57,515	120	2.09	49	9,694	196	5.93
Oliver and Slope.....	11,438	24	2.10	18	2,600	144	4.40
Stark.....	91,842	137	1.49	96	24,200	252	3.80
Ward.....	650,427	934	1.44	192	49,951	260	13.02
Williams.....	24,529	55	2.24	35	6,076	160	4.03
Total North Dakota.....	2,500,202	3,752	1.50	1,092	223,777	223	11.17
SOUTH DAKOTA							
Corson.....	38,909	74	\$1.90	22	5,350	243	7.27
Harding and Perkins.....	1,755	4	2.28	7	540	77	3.26
Total South Dakota.....	40,664	78	1.92	29	5,890	203	6.90
TEXAS							
Total Texas: Henderson, Milam, and Wood.....	144,144	127	\$0.88	68	8,762	129	16.46

¹ Based upon "calculated" man-days.² Output is obtained chiefly from strip pits in which production per man per day is large.

METHODS OF RECOVERY

TABLE 45.—*Lignite mined by different methods in the United States in 1943, by States, in net tons*

State	Mined by hand	Shot off the solid	Cut by machines ¹	From strip pits	Total
Montana, South Dakota, and Texas.....	(²)	78,453	-----	170,738	249,191
North Dakota.....	11,387	128,153	610,940	1,749,722	2,600,202
Total.....	11,387	206,606	610,940	1,920,460	2,749,393

¹ Total of 21 machines used—17 "permissible" and 4 other types.² Small amount of "Mined by hand" included under "Shot off the solid."

NUMBER AND SIZE OF MINES

For 1943 the Bureau of Mines received reports from 131 lignite mines (exclusive of some mines producing less than 1,000 tons a year). Most of the operations were in North Dakota, which had 106; Montana was next in order, with 15 mines; and South Dakota and Texas followed with 7 and 3, respectively. The classification by size of output in the field as a whole in 1943 is given in table 46.

TABLE 46.—*Number and production of lignite mines in the United States in 1943, classified by size of output*

Class	Mines		Production		
	Number	Percent of total	Net tons		Percent of total
			Total	Average per mine	
1. 200,000 tons and over.....	6	4.6	2,000,507	333,418	72.8
2. 100,000 to 200,000 tons.....	1	.8	126,904	126,904	4.6
3. 50,000 to 100,000 tons.....	2	1.6	137,266	68,633	5.0
4. 10,000 to 50,000 tons.....	14	10.7	280,588	20,042	10.2
5. Under 10,000 tons.....	108	82.4	204,128	1,890	7.4
Total.....	131	100.0	2,749,393	20,988	100.0

STRIPPING OPERATIONS

The production of lignite from strip pits in 1943 amounted to 1,920,460 tons—70 percent of the total output of the industry. As for many years, most of the stripping—that is, 91 percent of all strip-pit production and 64 percent of the total tonnage produced by the lignite industry—was done in North Dakota, where 1,749,722 tons were produced by that method. The output from stripping in Texas, Montana, and South Dakota was only 170,738 tons. The number of men employed was 589, with an average output per man per day of 15.99 tons, and the average number of days worked was 221.

Detailed statistics for stripping operations in the lignite industry in 1943 are given in table 47.

TABLE 47.—*Summary of stripping operations that produced lignite in the United States in 1943, by States*

State	Number of strip pits ¹		Coal produced (net tons)		Total value at mines (thousand dollars)	Average value per ton	Number of employees			Average number of days mines operated	Man-days of labor ²	Average tons per man per day ³	
	Number of shovels, drag-line excavators, and coal-loading machines ⁴		Mined by strip-ping	Total at same mines			Underground	Surface					Total
								In strip pits	All others				
Montana and Texas.....	4	4	131,679	131,679	123	\$0.93	—	20	8	28	246	6,898	19.09
North Dakota.....	52	51	1,749,722	1,914,063	2,787	1.46	49	324	165	538	219	118,085	16.21
South Dakota.....	5	5	39,059	39,059	74	1.89	—	21	2	23	235	5,410	7.22
Total.....	61	60	1,920,460	2,084,801	2,984	1.43	49	365	175	589	221	130,393	15.99

¹ Includes some pits in which stripping is done by hand.

² In some cases the same equipment was used for stripping or excavating and for loading coal; such duplication has been eliminated. In some cases the coal was excavated by machine and loaded by hand.

³ Based upon calculated man-days.

IMPORTS AND EXPORTS¹TABLE 48.—*Bituminous coal¹ imported for consumption in the United States 1943-44, by countries and customs districts, in net tons*

	1943	1944		1943	1944
COUNTRY			CUSTOMS DISTRICT—Continued		
North America:			Los Angeles.....		68
Canada.....	746,573	631,988	Maine and New Hampshire.....	106,853	108,709
Mexico.....	72		Maryland.....	784	
South America:			Massachusetts.....	5,542	
Chile.....		68	Michigan.....		(?)
Colombia.....		16	Montana and Idaho.....	498,072	430,734
Europe:			New York.....	4,258	1,263
U. S. S. R.....		370	Oregon.....		370
United Kingdom ²	10,989	1,221	Philadelphia.....	1,383	866
Africa: Union of South Africa.....		26	Washington.....	106,183	71,243
	757,634	633,689		757,634	633,689
CUSTOMS DISTRICT					
Alaska.....	33,349	19,930			
Buffalo.....	483				
Dakota.....	604	340			
Duluth and Superior.....	123	166			

¹ Includes slack, culm, and lignite.² Less than 1 ton.³ United Kingdom of Great Britain and Northern Ireland.⁴ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.TABLE 49.—*Exports of bituminous coal to Canada and Mexico, the West Indies and Central America, and "overseas" destinations, 1940-44, in thousands of net tons*

Year	Canada and Mexico	West Indies and Central America ¹	"Overseas" (all other countries)							Grand total
			Newfoundland, Miquelon, Bermuda, Greenland, and Iceland	South America	Europe	Asia	Africa	Oceania	Total "overseas"	
1940.....	13,537	455	106	1,660	653	29	26		2,474	16,466
1941.....	18,196	332	186	1,541	370	25	62	28	2,212	20,740
1942.....	21,017	440	90	925	253	4	214		1,486	22,943
1943.....	24,272	462	111	589	294		108		1,102	25,836
1944.....	24,370	356	157	580	222	(?)	351		1,310	26,036

¹ Includes Bahamas and Panama.² 35 tons.

TABLE 50.—*Bituminous coal exported from the United States, 1943-44, by countries, in net tons*¹

Country	1943	1944	Country	1943	1944
North America:			South America—Continued.		
Bermuda.....	6,261	6,873	Chile.....	16,438	15,991
Canada.....	24,269,585	24,366,878	Falkland Islands.....	1,214	94
Central America:			Peru.....		55
British Honduras.....	66	38	Surinam.....	2,299	4,345
Costa Rica.....	168	2,551	Uruguay.....	82,819	46,944
El Salvador.....		96	Venezuela.....		20
Guatemala.....	94	172	Other South America.....	9	136
Honduras.....	103	619		589,329	579,755
Nicaragua.....	7	48			
Panama:			Europe:		
Canal Zone.....	47,757	53,626	Azores.....	8,359	
Republic of.....	6	13	Portugal.....	267,600	213,370
Greenland.....	2,836	1,170	Spain.....	5,594	4,507
Mexico.....	2,323	2,981	U. S. S. R.....	11,929	4,213
Newfoundland and Labrador.....			Other Europe.....	49	49
West Indies:				293,531	222,139
British:			Asia: Arabia Peninsula		
Barbados.....		3,572	States.....		35
Jamaica.....	19,757	45,741			
Trinidad and Tobago.....	143,597	73,739	Africa:		
Other British.....	114	4,002	Algeria.....		278,980
Cuba.....	233,728	148,559	Canary Islands.....	7,131	20,748
Curacao (N. W. I.).....	172	347	Cape Verde Islands.....	3,384	13,962
Dominican Republic.....	69	1,985	Egypt.....	77,740	1
French.....	16,132	20,469	Madeira Islands.....	9,433	9,073
Haiti.....	16	36	Morocco: Spanish.....	10,662	25,693
			Other Africa.....		2,759
	24,844,998	24,882,565		108,350	351,216
South America:			Grand total.....	25,836,208	26,035,710
Argentina.....	128,172	196,165			
Bolivia.....	20,409	26,571			
Brazil.....	337,969	289,434			

¹ Amounts stated do not include fuel or bunker coal loaded on vessels engaged in the foreign trade, which aggregated 1,646,561 tons in 1943 and 1,559,335 tons in 1944.

TABLE 51.—*Bituminous coal exported from the United States, 1943-44, by customs districts, in net tons*

	1943	1944		1943	1944
North Atlantic:			Pacific Coast:		
Maine and New Hampshire.....	5,620	11,009	Los Angeles.....	37	394
Massachusetts.....	4	2	San Diego.....	106	82
New York.....	23,694	26,164	Washington.....	18,642	4,853
Philadelphia.....	279,424	307,671	Northern border:		
South Atlantic:			Buffalo.....	1,513,678	1,696,084
Maryland.....	101,711	168,541	Chicago.....	1,058,754	1,582,563
North Carolina.....	1,682	-----	Dakota.....	55,100	7,478
Virginia.....	900,768	1,020,947	Duluth and Superior.....	270,131	365,798
Gulf Coast:			Michigan.....	2,539,950	1,821,036
Florida.....	202,358	286,731	Ohio.....	11,764,246	12,094,748
Mobile.....	84,362	57,716	Rochester.....	4,146,174	3,318,098
New Orleans.....	26,964	25,910	St. Lawrence.....	2,834,424	3,227,283
Mexican border:			Vermont.....	692	5,049
Arizona.....	792	428	Wisconsin.....	581	125
El Paso.....	1,116	1,612	Miscellaneous: Alaska.....	5,192	5,387
Laredo.....	6	1		25,836,208	26,035,710

TABLE 52.—*Shipments of bituminous coal to noncontiguous Territories, 1943-44*

Territory	1943		1944	
	Net tons	Value	Net tons	Value
Alaska:				
Anthracite.....	11,269	\$161,730	15,425	\$210,331
Bituminous.....				
Hawaii.....	571	15,263	429	13,965
Puerto Rico.....	13,860	78,727	6,234	40,558

WORLD PRODUCTION

TABLE 53.—*World production of coal and lignite, 1938-44, by countries, in thousands of metric tons*¹

(Compiled by B. B. Waldbauer)

Country ¹	1938	1939	1940	1941	1942	1943	1944
North America:							
Canada:							
Coal.....	9,815	10,985	12,638	12,872	13,018	11,591	11,336
Lignite.....	3,153	3,094	3,298	3,662	4,096	4,610	4,095
Greenland.....	7	(²)	6	7	5	7	8
Mexico.....	893	628	816	856	908	1,053	843
United States:							
Anthracite.....	41,820	46,708	46,706	51,136	54,728	55,015	56,876
Bituminous.....	313,473	355,445	415,336	463,908	525,948	532,903	562,452
Lignite.....	2,720	2,760	2,666	2,518	2,659	2,494	
South America:							
Brazil.....	883	1,047	1,336	1,408	1,757	2,034	(²)
Chile.....	2,044	1,850	1,934	2,062	2,151	2,277	* 2,288
Colombia.....	331	349	521	403	415	476	(²)
Peru.....	75	108	153	117	150	187	(²)
Venezuela.....	6	3	5	6	9	11	(²)
Europe:							
Albania: Lignite.....	4	(²)	(²)	(²)	(²)	(²)	(²)
Belgium.....	29,585	29,847	25,607	* 25,855	* 24,884	23,094	(²)
Bulgaria:							
Coal.....	142	164	188				
Lignite.....	1,855	2,134	2,700	2,256	2,781	* 2,000	(²)
Czechoslovakia:							
Coal.....	15,800	(²)	(²)	(²)	(²)	(²)	(²)
Lignite.....	14,717	* 779	* 805	* 816	* 813	(²)	(²)
Denmark: Lignite.....	(²)	(²)	(²)	* 1,000	* 1,800	* 2,400	(²)
Eire.....	120	120	118	155	167	186	(²)
Faroe Islands: Lignite.....	8	8	(²)	(²)	(²)	(²)	(²)
France:							
Coal.....	46,498	49,157	39,323	* 41,719	* 41,760	40,557	26,602
Lignite.....	1,057	1,853	(²)	(²)	(²)	(²)	(²)
Germany:							
Coal.....	186,177	200,000	(²)	(²)	* 139,000	(²)	(²)
Lignite.....	195,312	230,000	(²)	(²)	(²)	(²)	(²)
Austria:							
Coal.....	227	(²)	(²)	(²)	(²)	(²)	(²)
Lignite.....	3,342	(²)	(²)	(²)	(²)	(²)	(²)
Greece: Lignite.....	108	139	(²)	* 180	* 350	* 125	(²)
Hungary:							
Coal.....	1,042	1,107	1,207	(²)	* 1,500	(²)	(²)
Lignite.....	8,317	9,518	9,485	(²)	* 10,000	(²)	(²)
Italy:							
Coal.....	1,480	2,025	(²)	(²)	(²)	(²)	(²)
Lignite.....	873	1,058	(²)	(²)	(²)	(²)	(²)
Netherlands:							
Coal.....	13,488	12,861	12,149	* 12,855	* 12,520	12,497	(²)
Lignite.....	171	197	(²)	(²)	(²)	(²)	(²)
Poland:							
Coal.....	38,104	(²)	(²)	(²)	(²)	(²)	(²)
Lignite.....	10	(²)	(²)	(²)	(²)	(²)	(²)
Portugal:							
Coal.....	299	299	369	435	438	403	* 431
Lignite.....	15	35	64	84	108	106	* 130
Rumania:							
Coal.....	299	285	(²)	(²)			
Lignite.....	2,097	2,300	(²)	(²)	* 6,500	(²)	(²)
Spain:							
Coal.....	5,649	6,606	8,862	8,783	9,257	9,591	* 10,434
Lignite.....	166	194	569	793	1,106	1,112	* 1,204
Svalbard (Spitsbergen).....	627	640	(²)	(²)	(²)	(²)	(²)
Sweden.....	431	444	498	557	582	(²)	(²)
Switzerland:							
Coal.....	3	3	8	72	184	157	71
Lignite.....				8	27	75	74
United Kingdom:							
Great Britain.....	230,650	235,051	227,898	209,656	206,901	197,615	188,446
Northern Ireland:							
Coal.....	(²)	(²)	(²)	(²)	3	(²)	(²)
Lignite.....			(²)	(²)	1	1	(²)
U. S. S. R.:							
Coal.....	98,627	134,500	148,700	146,800	* 90,000	* 131,400	(²)
Lignite.....		(²)	(²)	(²)	(²)	(²)	(²)
Yugoslavia:							
Coal.....	450	444	* 3,170	7,310	* 11,160	(²)	(²)
Lignite.....	5,287	5,622					

See footnotes at end of table.

TABLE 53.—*World production of coal and lignite, 1938–44, by countries, in thousands of metric tons*¹—Continued

Country ¹	1938	1939	1940	1941	1942	1943	1944
Asia:							
British Borneo.....	(²)	(²)	(²)	(²)	(²)	(²)	(²)
China (Free).....	4,260	4,568	5,716	6,000	5,652	5,995	5,458
Manchuria.....	15,000	19,000	21,630	24,500	25,500	(²)	(²)
Chosen.....	3,200	4,481	(²)	(²)	(²)	(²)	(²)
Federated Malay States.....	486	448	794	(²)	(²)	(²)	(²)
India.....	28,798	28,214	26,000	29,937	29,906	26,000	(²)
Indochina:							
Coal.....	2,340	2,588	2,456	¹⁰ 1,117	¹⁰ 732	1,293	(²)
Lignite.....	4	27	30	(²)	(²)	(²)	(²)
Japan:							
Japan proper:							
Coal.....	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Lignite.....	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Karafuto.....	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Taiwan.....	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Netherlands Indies.....	1,457	1,781	2,009	¹¹ 778	(²)	(²)	(²)
Philippine Islands.....	41	47	(²)	(²)	(²)	(²)	(²)
Syria and Lebanon: Lignite.....	(²)	1	2	(²)	(²)	(²)	(²)
Turkey:							
Coal.....	2,589	2,696	3,019	3,020	2,510	3,163	3,530
Lignite.....	129	151	219	264	409	589	760
U. S. S. R.:							
Coal.....	34,261	(²)	(²)	(²)	(²)	(²)	(²)
Lignite.....							
Africa:							
Algeria:							
Coal.....	13	(²)	50	80	148	117	120
Lignite.....				3	7	1	(²)
Belgian Congo: Coal.....	42	(²)	23	30	43	69	(²)
Madagascar.....	(²)	(²)	(²)	1	2	6	(²)
Morocco, French.....	123	116	143	140	118	102	300
Nigeria.....	368	311	313	(²)	(²)	(²)	(²)
Portuguese East Africa.....	10	8	20	17	7	13	(²)
Southern Rhodesia.....	1,044	1,118	¹² 1,257	¹² 1,399	¹² 1,487	¹² 1,713	(²)
Tunisia: Lignite.....		2	28	102	133	39	65
Union of South Africa.....	16,284	16,890	17,176	18,337	20,408	20,561	¹⁰ 12,493
Oceania:							
Australia:							
New South Wales.....	9,725	11,376	9,703	11,955	12,433	11,714	(²)
Queensland.....	1,131	1,339	1,306	1,477	1,663	(²)	(²)
Tasmania.....	85	99	84	111	137	148	146
Victoria:							
Coal.....	312	371	272	332	318	281	(²)
Lignite.....	3,734	3,710	4,347	4,639	5,013	5,172	(²)
Western Australia.....	614	566	548	566	591	540	(²)
New Zealand:							
Coal.....	994	1,061	1,163	1,199	1,194	1,157	2,847
Lignite.....	1,264	1,319	1,393	1,483	1,529	1,676	
Total, all grades.....	1,469,000	1,639,000	(²)	(²)	(²)	(²)	(²)
Lignite (total of items shown above).....	264,000	301,000	(²)	(²)	(²)	(²)	(²)
Bituminous and anthracite (by subtraction).....	1,205,000	1,338,000	(²)	(²)	(²)	(²)	(²)

¹ Coal is also mined in Argentina, Iran, and Italian East Africa, but production figures of those countries not available.

² Estimate included in total.

³ Data not yet available.

⁴ Estimate.

⁵ Fiscal year ended March 31 of year following that stated.

⁶ Estimated production of Slovakia only.

⁷ Estimated production of Ruhr only.

⁸ Production less than 1,000 tons.

⁹ Estimated production of Croatia only.

¹⁰ January to June, inclusive.

¹¹ Production of Government mines only.

¹² Tonnage raised by Wankie colliery for year ended August 31 of year stated.

PENNSYLVANIA ANTHRACITE

By J. A. CORGAN AND M. I. COOKE

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REVIEW OF 1944

Although production of Pennsylvania anthracite in 1944 totaled 63,701,363 net tons—a gain of 5 percent over 1943 and the highest output since 1930—demand exceeded production, and allocation was necessary to attain equitable distribution of the supplies available. Shortages of other space-heating fuels in the United States and Canada, expanded purchasing power of domestic consumers, and the high rate of industrial consumption were responsible for the heavy demand for anthracite. Scarcity of manpower and difficulty in obtaining equipment and supplies were the principal factors that limited production in 1944. Although deep-mine production declined slightly from 1943, the production from strip mines and culm banks was the highest on record, and the over-all industry gain of 3,057,743 tons is attributable almost entirely to increased output from these sources. The total of 292 days operated by the industry, including four Sundays worked in February, was exceeded only by the record of 293 days in 1918.

In direct contrast to the unsettled labor conditions that caused an estimated production loss of 5,700,000 tons in 1943, no general stoppages of work occurred in the anthracite industry in 1944. Continuity of operations was threatened, however, because of the absence of a contract. As a result, the Secretary of the Interior continued the control measures established early in 1943 and did not relinquish possession of the mines until June 21, 1944, 4 days after a contract was signed by the operators and miners.

The Anthracite Distribution Program inaugurated in 1943 by Solid Fuels Administration for War was continued through 1944 because of a scarcity of fuels. The Bureau of Mines continued to work closely with the Solid Fuels Administration for War in compiling current detailed statistical data relating to distribution, production, consumption, utilization, and market requirements of anthracite upon which the program for fair distribution of anthracite was based.

The Bureau of Mines, through congressional appropriation, conducted research in the anthracite fields to determine ways to increase the production of anthracite by extending underground mechanization, especially in the pitching seams of the Southern and Western Middle fields, where mechanical mining has made little progress in the past. Investigations were conducted also to determine means of controlling mine water and preventing flooding of the mines. It is expected that the present investigative work will lead to the development of major projects for future consideration.

Research and experimental work conducted by Anthracite Industries, Inc., for many years on the development of new, low-cost, automatic coal-burning equipment has been fruitful, as evidenced by the announcement of the development of an entirely new principle for the utilization of anthracite. The laboratory at Primos, Pa., conducted an expanded program on the development of auxiliary heating equipment and, at the same time, served as a source of technical information for manufacturers of coal-burning equipment.

According to the Anthracite Committee, production of "bootleg" anthracite totaled 1,333,000 net tons during 1944, compared with 1,912,000 tons in 1943, a decrease of 30 percent. Production from this source has declined rapidly since 1941, when the output reached 6,300,000 tons. The chief contributing factor in the decline has been the loss of miners to the armed forces, to nearby war industries, and to established mining companies.

Definition of Pennsylvania anthracite.—The term "Pennsylvania anthracite," so far as this report is concerned, includes all nonbituminous coal mined in Pennsylvania and, for historical purposes, the coal produced in the Bernice Basin in Sullivan County, the latter being officially classified as semianthracite. The anthracite fields are in the northeastern part of the State, and the coal is mined in the following counties: Carbon, Columbia, Dauphin, Lebanon, Lackawanna, Luzerne, Northumberland, Schuylkill, Susquehanna, and Wayne.

Statistical trends.—Tables 1 and 2 present pertinent statistical data on the Pennsylvania anthracite industry.

The war and anthracite.—Despite labor shortages and difficulty in obtaining equipment and supplies, the anthracite industry increased its output 5 percent over 1943, making the tonnage of anthracite available for distribution greater in 1944 than in any year since the start of the war. Even with this substantial increase, however, it was impossible to meet requirements because of the disproportionate increase in demand brought about principally by continued shortages of oil and coke in this country and deficiencies of gas and oil in Canada for space heating. The allocation system established by the Solid Fuels Administration for War in 1943 was continued through 1944. Using statistics compiled by the Bureau of Mines from reports furnished by producers and wholesalers of anthracite, Solid Fuels

Administration for War was able to distribute equitably the available supplies of anthracite. Data for the 1942-43 coal year were used as a base in determining allowable shipments to retail coal merchants and in relieving local shortages, whereas monthly statistics were used to

TABLE 1.—Statistical trends of Pennsylvania anthracite industry, 1940-44

	1940	1941	1942	1943	1944
Production:					
Loaded at mines for shipment:					
Breakers.....net tons..	¹ 43,800,127	46,864,422	51,173,756	¹ 50,812,873	53,067,227
Washeries.....do.....	¹ 1,761,942	2,538,692	1,957,920	¹ 2,401,065	3,492,187
Dredges.....do.....	613,884	1,008,983	778,019	821,899	1,061,156
Sold to local trade and used by employees.....net tons..	3,052,626	3,695,125	4,059,403	4,233,732	3,765,641
Used at collieries for power and heat.....net tons..	2,256,061	2,261,045	2,358,625	2,374,051	2,295,152
Total production.....do.....	51,484,640	56,368,267	60,327,729	60,643,620	63,701,363
Value at breaker, washery, or dredge..	\$205,490,000	\$240,275,000	\$271,673,000	\$306,816,018	\$354,582,884
Average sales realization per net ton on breaker shipments:					
Domestic:					
Lump and Broken.....	\$5.49	\$5.72	\$6.03	\$6.77	\$7.47
Egg.....	5.32	5.84	6.24	6.96	7.56
Stove.....	5.47	5.93	6.26	6.96	7.57
Chestnut.....	5.49	5.93	6.28	6.97	7.58
Pea.....	4.13	4.50	4.85	5.48	6.11
Total domestic.....	5.24	5.68	6.05	6.76	7.38
Steam:					
Buckwheat No. 1.....	3.18	3.37	3.46	4.00	4.52
Buckwheat No. 2 (Rice).....	2.35	2.52	2.63	3.12	3.59
Buckwheat No. 3 (Barley).....	1.68	1.78	1.89	2.25	2.53
Other, including Buckwheat No. 4..	0.92	1.02	1.09	1.42	1.67
Total steam.....	2.41	2.55	2.58	3.02	3.42
Total all sizes.....	4.27	4.59	4.79	5.38	5.91
Percent by sizes in total breaker shipments:					
Domestic:					
Lump and Broken.....	0.3	0.3	0.3	0.4	0.3
Egg.....	4.5	4.2	5.2	7.1	7.1
Stove.....	24.1	24.3	23.6	22.4	21.9
Chestnut.....	25.9	25.5	24.9	24.5	25.2
Pea.....	11.1	10.8	9.6	8.7	8.3
Total domestic.....	65.9	65.1	63.6	63.1	62.8
Steam:					
Buckwheat No. 1.....	14.7	14.6	14.5	14.2	14.2
Buckwheat No. 2 (Rice).....	7.8	8.2	8.0	8.3	8.5
Buckwheat No. 3 (Barley).....	8.8	8.9	9.6	9.9	9.7
Other, including Buckwheat No. 4..	2.8	3.2	4.3	4.5	4.8
Total steam.....	34.1	34.9	36.4	36.9	37.2
Producers' stocks ² net tons..	939,000	1,274,000	798,000	329,000	445,000
Exports ³ do.....	2,668,000	3,380,000	4,439,000	4,139,000	4,186,000
Imports ³ do.....	135,000	75,000	140,000	166,000	12,000
Consumption (calculated).....do.....	49,000,000	52,700,000	56,500,000	57,100,000	59,400,000
Average number of days worked.....	186	203	239	270	292
Man-days lost on account of strikes and lock-outs.....	176,432	397,616	279,641	(⁴)	(⁴)
Number of men on strike during year..	19,464	39,768	26,631	(⁴)	(⁴)
Average number of men employed.....	91,313	88,054	82,121	79,153	77,591
Output per man per day.....net tons..	3.02	3.04	2.95	2.78	2.79
Output per man per year.....do.....	562	617	705	751	815
Quantity cut by machines.....do.....	1,816,483	1,855,422	2,285,640	1,624,883	1,336,082
Quantity mined by stripping.....do.....	6,352,700	7,316,574	9,070,933	8,989,387	10,953,030
Quantity loaded by machines underground.....net tons..	12,326,000	13,441,987	14,741,459	14,745,793	14,975,146
Distribution:					
Total receipts in New England ⁵ net tons..	4,822,000	5,551,000	5,974,000	5,722,000	6,222,000
Exports to Canada ³ do.....	2,627,000	3,361,000	4,418,000	4,097,000	4,144,000
Loaded into vessels at Lake Erie ⁶ net tons..	430,000	553,000	575,000	661,000	1,066,000
Receipts at Duluth-Superior ⁷ do.....	138,000	236,000	222,000	302,000	580,000

¹ Small quantity of washery coal included under "Breakers."

² Anthracite Committee.

³ U. S. Department of Commerce.

⁴ Data not available.

⁵ Commonwealth of Massachusetts, Division on the Necessaries of Life, and Association of American Railroads.

⁶ Ore and Coal Exchange, Cleveland, Ohio.

⁷ U. S. Engineer Office, Duluth, Minn.

TABLE 2.—Statistical summary of monthly developments in the Pennsylvania anthracite industry in 1944

(All tonnage figures represent net tons)

	1944												1943 (total)		
	Janu- ary	Febru- ary	March	April	May	June	July	August	Sep- tember	October	Novem- ber	Decem- ber		Year	
														Total	Change from 1943 (per- cent)
Production, including mine fuel, local sales, and dredge coal:															
Monthly total	4,970,000	5,811,000	5,512,000	5,141,000	5,781,000	5,538,000	4,905,000	5,558,000	5,380,000	5,538,000	5,029,000	4,518,000	63,701,000	+5.0	60,644,000
Shipments, breakers and wash- eries only: ¹															
Monthly total, all sizes	4,090,112	4,790,263	4,541,076	4,174,836	4,742,485	4,630,409	4,281,899	4,719,591	4,605,264	4,653,509	4,203,501	3,782,071	53,215,046	+6.7	49,877,658
Distribution:															
Lake Erie loadings: ²			6,789				163,152	121,921	137,779	153,416	70,771		1,066,389	+61.3	660,929
Receipts at Duluth-Superior: ³				39,933	50,106	104,952	96,262	57,493	80,360	98,892	51,830		579,828	+91.9	302,087
Upper Lake dock trade: ⁴															
Receipts:															
Lake Superior	79			19,806	16,327	102,945	96,187	59,886	80,375	98,937	51,832		526,374	+269.9	142,285
Lake Michigan	1,401	779	1,854	38,593	50,440	61,445	55,417	50,211	51,973	39,124	9,931	2,404	363,572	+10.5	328,893
Deliveries (reloadings):															
Lake Superior	6,461	2,991	1,902	4,398	17,962	53,044	39,108	66,155	69,925	68,311	59,357	65,380	454,994	+172.0	167,289
Lake Michigan	22,488	19,714	28,264	21,653	27,225	36,025	31,085	34,649	33,302	36,054	26,502	24,269	341,230	-2.2	348,828
New England receipts:															
By tide: ⁵	27,187	20,787	33,079	33,623	39,641	26,410	25,535	35,941	30,811	39,157	43,176	30,695	386,042	-6.1	411,301
By rail: ⁶	472,563	545,588	562,660	445,994	502,454	479,936	476,863	495,808	480,347	530,499	442,300	401,418	5,836,330	+9.9	6,310,391
Exports: ⁷	297,915	329,082	327,859	300,018	346,517	354,380	343,393	374,571	398,944	436,374	394,082	282,798	4,185,933	+1.1	4,138,680
Imports: ⁸		5,203	6,635										11,847	-92.9	1,166,020
Industrial consumption and stocks by:															
Railroads (class 1 only): ⁹	114,824	113,129	117,766	95,520	78,647	72,780	69,719	71,424	68,880	85,250	95,370	110,639	1,093,651	-8.6	1,196,058
Consumption	137,415	129,545	115,239	116,731	116,895	141,138	105,637	178,015	201,344	203,087	202,954	194,534	1,194,534	+34.9	144,168
Stocks:															
Electric-power utilities: ⁹															
Consumption	299,447	280,812	283,958	242,971	267,746	278,257	296,640	321,087	286,775	290,421	289,651	289,214	3,427,479	+4.8	3,260,520
Stocks	1,720,539	1,673,127	1,617,393	1,630,141	1,623,448	1,646,675	1,628,373	1,623,998	1,662,859	1,718,567	1,709,467	1,654,132	1,654,132	-8.3	1,804,663
Other industrial consumers: (Selected representative plants),															

Stocks, end of month.....	678,030	708,415	705,493	749,018	784,034	884,549	904,841	939,603	748,551	1,390,431	860,109	(¹)	1,104,734
Consumed during month.....	108,030	222,783	240,913	225,341	201,771	202,568	228,830	245,827	237,212	330,225	324,063	(¹)	(¹)
Supply, end of month (days).....	108,030	215,030	240,913	225,341	201,771	202,568	228,830	245,827	237,212	330,225	324,063	(¹)	(¹)
Number of firms reporting.....	609	628	674	687	717	714	724	684	731	709	705	(¹)	617
Realt. dealers (Selected representative plants)													
Stocks, end of month.....	108,607	114,531	94,720	388,098	522,809	639,281	723,492	711,140	776,331	924,068	1,033,393	824,199	97,070
Deliveries during month.....	293,011	320,833	328,561	1,056,222	1,080,425	1,271,266	1,124,548	1,269,314	1,291,066	1,339,007	1,260,751	1,351,507	(¹)
Supply, end of month (days).....	11	10	9	11	15	15	20	17	18	21	25	19	(¹)
Number of dealers reporting.....	1,325	1,277	1,331	3,320	3,215	3,562	3,648	3,604	3,553	3,649	3,747	3,567	1,081
Stocks on Upper Lake docks: 4													
Lake Superior.....	21,540	18,548	16,431	31,839	29,689	108,138	165,217	157,330	107,780	108,406	100,881	125,500	+340.5
Lake Michigan.....	64,969	46,034	19,624	36,564	59,779	85,199	109,531	125,063	143,764	146,834	130,263	108,431	+26.0
Producers' stocks 10.....	288,545	253,581	318,278	334,331	352,529	347,868	378,340	412,991	442,391	461,535	491,530	444,508	+35.2
Prices at mines, average per ton: 11													
Company Stove.....	\$8.00	\$8.45	\$8.11	\$8.00	\$8.00	\$7.85	\$7.85	\$7.85	\$7.85	\$7.85	\$7.85	\$7.96	+8.2
Company Buckwheat No. 1.....	\$4.80	\$5.25	\$4.91	\$4.80	\$4.80	\$4.65	\$4.65	\$4.65	\$4.65	\$4.65	\$4.65	\$4.76	+12.0
Wholesale prices: 12													
On tracks, destination:													
Chestnut.....	\$11.42	\$11.72	\$11.48	\$11.53	\$11.57	\$11.44	\$11.42	\$11.42	\$11.42	\$11.42	\$11.43	\$11.47	+5.3
Pea.....	\$9.98	\$10.33	\$10.05	\$10.11	\$10.16	\$10.04	\$10.03	\$10.03	\$10.03	\$10.04	\$10.04	\$10.07	+6.4
Index numbers (1926=100).....	95.0	97.8	95.6	95.8	96.4	95.5	95.4	95.4	95.4	95.3	95.3	95.6	+5.8
Labor conditions: 13													
Average weekly earnings.....	\$45.05	\$58.12	\$48.67	\$44.36	\$48.54	\$47.10	\$43.22	\$48.21	\$47.45	\$51.08	\$44.39	\$48.39	+10.9
Index of employment (1939 average=100).....	83.4	84.2	83.5	82.6	82.7	83.0	77.9	77.9	81.5	80.5	79.9	79.2	81.4
Index of payroll totals (1939 average=100).....	146.0	190.2	157.8	142.3	155.8	151.8	130.6	145.8	150.1	159.8	137.7	148.8	+13.1

¹ U. S. Department of Commerce.

² Furnished by Anthracite Institute.

³ Ore and Coal Exchange, Cleveland, Ohio.

⁴ U. S. Engineer Office, Duluth, Minn.

⁵ Includes all commercial docks on Lake Superior and west shore of Lake Michigan as far south as Kenosha. Based on data courteously supplied by Maher Coal Bureau and direct reports to the Bureau of Mines.

⁶ Association of American Railroads.

⁷ Furnished by Commonwealth of Massachusetts, Division on the Necessaries of Life.

⁸ Represents coal in storage closest available date to end of month.

⁹ Anthracite Committee. Represents coal in storage closest available date to end of month.

¹⁰ Computed from weekly quotations from trade journals. Figures represent circular prices quoted on while ash by leading anthracite-producing companies.

¹¹ Bureau of Labor Statistics.

control supplies between producers and wholesalers. Shipments of domestic and Buckwheat No. 1 sizes to retailers were limited for the first 7 months to 90 percent of adjusted average monthly receipts of those sizes during the 1942-43 coal year and 87.5 percent during the last 5 months when the supply situation became more acute. Regulation of delivery of all sizes was not necessary, as some of the steam coal was in surplus throughout the year. The success attained in distributing anthracite equitably would not have been possible without the cooperation of the producers, wholesalers, and retailers of anthracite.

Anthracite Industries, Inc.—Anthracite Industries, Inc., continued its enlarged scope of research activities, announcing the development of the "Anthratable," a device for utilizing an entirely new method of burning anthracite. The device consists primarily of a horizontal, steel combustion chamber, 18 inches in length and 6 inches in diameter, into which anthracite is pushed by a mechanical worm and where it burns with great intensity under forced draft. A water jacket surrounds the hot part of the tube; and the water, absorbing the heat from the steel, can be circulated through radiators for space heating. It is anticipated that the complete unit will require a space of approximately 2 by 2 by 3 feet and that it will play an important part in competing for the postwar fuel markets. In addition, the laboratory (Primos, Pa.) continued research in the design of other new anthracite-burning equipment and the development of auxiliary equipment to improve the efficiency and convenience of the equipment now in use. Manufacturers of coal-burning equipment and regulatory devices are encouraged by Anthracite Industries, Inc., to cooperate with the laboratory.

Anthracite Committee.—The Anthracite Committee has served the industry not only by representing the producers before various Government agencies in matters affecting their operations but by supplying current statistics on production, employment, and other pertinent phases of the industry, by predicting production trends, and by furnishing information concerning the activities of the "bootleg" mining industry.

Anthracite Institute.—The Anthracite Institute through its expanded information services continued to keep the operators apprised of the many Government regulations regarding the distribution of anthracite, as well as matters relating to freight rates, State and Federal legislation, and many other subjects of interest to the industry. Representatives of the institute cooperated with producers of other solid fuels and members of the transportation industry in opposing the extension of natural gas pipe lines into the eastern markets.

Labor.—There was an acute shortage of labor in the anthracite-mining industry in 1944, especially of men to work at the face; output, no doubt, would have been much greater had sufficient labor been available. In accordance with an agreement between the operators and the miners made early in 1943, the mine workers continued to work 6 days a week throughout 1944. The miners worked 7 days a week in February to increase the output of anthracite, thereby alleviating the shortage of that fuel in its principal markets. The mine workers were paid double time for the extra work, provided they worked the 6 consecutive days before Sunday, and the Office of Price Administration authorized an increase in f. o. b. mine prices

of anthracite to compensate for added costs of production occasioned by the Sunday work. The average number of mine workers employed in 1944 was 77,591, a slight decline from the previous year. On June 17, 1944, after negotiating for about 15 months, the anthracite-mine operators and the United Mine Workers of America signed a new wage contract through April 30, 1945, to supersede the one that expired on April 30, 1943. On two occasions during the period between the expiration of the old agreement and the signing of the new one, the Federal Government took possession of the mines when the miners failed to report for work because of the absence of a contract. On June 21, 1944, the Secretary of the Interior issued Order CMA 39, bringing to a close almost 13 months of continuous Government custody of the mines—from May 1, to October 12, 1943, and from November 1, 1943, to June 21, 1944.

Research.—The Bureau of Mines commenced investigative work in the anthracite fields on increasing the output per man per day of anthracite through new and improved methods of mining anthracite mechanically. Mechanical mining, particularly in the flat areas of the Northern field, has been in effect for many years, but the bulk of the production must eventually come from the pitching seams of the Western Middle, and Southern fields, where mechanization has made slow progress. It is hoped that through extended mechanization mining costs may be reduced, enhancing the economic status of the industry in the postwar period. Concurrently with the mechanization program, investigations were made on control of mine water and flood prevention. Work on flood prevention has been carried on for a number of years by individual companies, but to be effective major problems must be solved on a collective basis. This requires a coordination of jurisdictional bodies and property owners, as well as an established means of financing. Headquarters for the Bureau's activities on these subjects have been established at Wilkes-Barre, Pa.

With a view toward relieving the wartime shortage of certain special metallurgical coals several byproduct-coke plants blended fine-size anthracite with bituminous coal to manufacture coke. Other plants are conducting experiments on blends containing anthracite fines. Reports received by the Bureau indicate that 188,000 net tons of anthracite were used in this manner in 1944. This experimental work has been encouraged by the Solid Fuels Administration for War, not only to alleviate the shortage of low-volatile bituminous coal used in producing coke but also to establish a market for surplus anthracite fines brought about by increased production of the domestic sizes. Details on research and investigations by the Bureau of Mines on the use of anthracite fines at 21 byproduct coke plants were published in Report of Investigations 3808, Utilization of Anthracite Fines in the Manufacture of Byproduct Coke.

The cooperative research program at the Pennsylvania State College, which has been financially supported for 4 years by the Commonwealth of Pennsylvania and the anthracite industry, was extended for a period ending May 31, 1945.

Research conducted by Anthracite Industries, Inc., is discussed in the preceding text of this chapter.

Competitive fuels in the United States and principal markets.—More than 96 percent of the anthracite shipped from the mines to points

in the United States is destined to the New England States, the Middle Atlantic States, Delaware, Maryland, and the District of Columbia. Data on the consumption of all fuels in these markets are not available; however, the apparent consumption of anthracite, coke, briquets, and heating and range oils in terms of anthracite in 1943 declined 3.7 percent from 1942. The decline is attributable entirely to decreased shipments of heating and range oil and coke to these markets. Anthracite shipments increased slightly in 1943 over 1942, supplying 61.7 percent of the total equivalent fuels consumed in these States. In addition to the legitimate anthracite shipped, large quantities of "bootleg" coal are moved by truck to this area. Although complete data for 1944 are not available, it is believed

TABLE 3.—*Apparent consumption of anthracite and selected competitive fuels in the principal anthracite markets, 1941-44*

[Thousands of net tons]

Fuel	New Eng- land	New York	New Jersey	Dela- ware	Mary- land	Penn- syl- vania	District of Co- lumbia	Total	
								Thou- sands of net tons	Percent of total fuels
Anthracite:									
All users: ¹									
1941.....	5,540	16,308	10,190	361	681	14,103	283	47,466	56.0
1942.....	5,844	17,988	10,395	373	835	15,813	298	51,546	59.2
1943.....	5,604	18,555	9,527	362	873	16,540	320	51,781	61.7
1944.....	6,004	17,489	10,254	380	1,016	17,744	325	53,212	(²)
Imports: ⁴									
1941.....	75							75	.1
1942.....	140	1						141	.2
1943.....	164	2						166	.2
1944.....	12							12	(²)
Briquets:									
Domestic use:									
1941.....	52	25	1	(⁵)	3	14	(⁵)	95	.1
1942.....	54	26	1	(⁵)	4	22	(⁵)	107	.1
1943.....	53	31	2	(⁵)	4	27	1	118	.1
1944.....	76	48	12	3	7	45		192	(²)
Imports: ⁴									
1941.....									
1942.....								(⁵)	
1943.....								(⁵)	
1944.....								(⁵)	
Coke:									
Domestic use:									
1941.....	1,363	1,350	470	1	28	474	2	3,688	4.3
1942.....	1,252	1,064	408	2	13	428	2	3,169	3.6
1943.....	1,265	969	329	3	1	321	(⁵)	2,888	3.4
1944.....	1,352	1,232	464	7	4	386	1	3,446	(²)
Imports: ⁴									
1941.....	65	51			107			223	.3
1942.....		56						56	.1
1943.....	1	52						53	.1
1944.....	(⁵)	23						23	(²)
Oil: Heating and range: ⁶									
1941.....	13,253	10,940	4,584	121	963	2,793	630	33,284	39.2
1942.....	11,875	10,659	4,890	158	1,061	2,817	651	32,111	36.8
1943.....	10,367	9,795	4,490	144	970	2,620	552	28,938	34.5
1944.....	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(²)
Total fuel: ⁷									
1941.....	20,348	28,674	15,245	483	1,782	17,384	915	84,831	100.0
1942.....	19,165	29,794	15,694	533	1,913	19,080	951	87,130	100.0
1943.....	17,454	29,404	14,348	509	1,848	19,508	873	83,944	100.0
1944.....	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(²)

¹ Pennsylvania Department of Mines; illicit coal not included.

² An important but undetermined part of anthracite shown as shipped to New Jersey is reshipped New York City.

³ Data not yet available.

⁴ U. S. Department of Commerce.

⁵ Less than 1,000 tons.

⁶ Converted to coal equivalent upon basis of 4 barrels of fuel oil equaling 1 ton of coal.

⁷ Excludes bituminous coal.

that the total consumption of fuels in these markets increased over 1943; slight gains are indicated for coke and anthracite, and it is believed that these gains will offset any small decline in consumption of heating oils. Details on consumption of competitive fuels are shown in table 3.

In general, supplies of fuels commonly used for space-heating purposes in the United States increased in 1944 over 1943, substantial gains being recorded in the consumption of anthracite and coke. Details on supplies of available fuels are given in table 4.

Distribution.—Tables 5 and 6 summarize detailed data, published jointly by the Bureau of Mines and Solid Fuels Administration for

TABLE 4.—Total supplies of fuels commonly used for space-heating purposes in the United States, 1937 and 1941-44

[Wherever available, figures represent quantity actually consumed for domestic heating or for space heating offices, apartments, hotels, schools, hospitals, etc. Where such figures are not available but where the fuel is known to be used chiefly for domestic or space-heating purposes, total production (or imports) is shown to indicate trend of growth]

	1937	1941	1942	1943	1944
SOLID FUELS (NET TONS)					
Anthracite:					
Production:					
Shipments of domestic sizes	29,092,974	30,912,649	32,924,518	32,563,787	34,343,434
Shipments of Buckwheat No. 1	6,859,707	7,357,542	7,789,168	7,537,642	8,083,664
Shipments of smaller steam sizes ¹	10,250,463	12,141,906	13,196,015	13,934,408	15,213,472
Local sales	2,981,391	3,695,125	4,059,403	4,233,732	3,765,641
Total commercial production	49,184,535	54,107,222	57,969,104	58,269,569	61,406,211
Exports ²	1,914,173	3,380,188	4,438,588	4,138,680	4,185,933
Imports for consumption (chiefly from United Kingdom and U. S. S. R.) ³	395,737	74,669	140,115	166,020	11,847
Fuel briquets ⁴	977,254	1,258,129	1,644,755	1,989,398	2,301,827
Packaged-fuel production	146,037	269,844	253,048	215,605	175,770
Coke:					
Byproduct sales for domestic use	7,807,792	6,596,969	5,963,474	4,784,090	6,443,329
Beehive sales for domestic use	299,726	85,990	98,220	101,438	274,214
Imports for consumption ⁵	286,364	267,886	108,782	98,127	63,004
Gas-house-coke sales	4,350,700	(⁶)	533,882	518,825	423,675
Petroleum-coke production	1,306,600	1,648,800	1,338,400	1,388,400	1,803,400
Anthracite and semianthracite production outside of Pennsylvania	468,852	(⁶)	(⁶)	(⁶)	(⁶)
Lignite production ⁶	3,218,419	2,775,832	2,930,661	2,749,393	(⁶)
Bituminous-coal sales for domestic use	(⁷)	(⁷)	(⁷)	(⁷)	(⁷)
OIL (BARRELS OF 42 GALLONS)					
Oil sales for heating buildings:					
Range oil	32,259,000	46,110,000	44,923,000	44,097,000	# 43,500,000
Heating oils: ⁸					
Domestic	116,617,000	167,514,000	168,989,000	155,251,000	# 151,000,000
Commercial	972,000	5,255,000	7,133,000	8,080,000	# 10,442,000
Liquefied petroleum gases, domestic					
GAS (MILLION CUBIC FEET)					
Natural-gas consumption for domestic and commercial use ¹⁰	489,234	586,911	682,140	684,007	749,189
Manufactured-gas sales for: ¹¹					
Domestic use	193,325	198,700	205,778	208,397	215,157
House heating	45,200	67,151	79,600	83,686	84,766

¹ A considerable part of the smaller steam sizes is used by industries, railroads, and public utilities.

² U. S. Department of Commerce.

³ Production plus imports less exports.

⁴ Partly estimated.

⁵ Data not available.

⁶ An estimated one-half is used for domestic purposes.

⁷ Exact data not available; estimated between 55 and 77 million tons a year, including lignite.

⁸ Estimated.

⁹ Includes all grades of fuel oil used for heating buildings.

¹⁰ Includes gas used for heating offices, hotels, apartments, hospitals, and stores, and other large buildings, as well as houses.

¹¹ American Gas Association.

TABLE 5.—*Distribution of Pennsylvania anthracite, Apr. 1, 1942–Mar. 31, 1943, by States, Provinces, and countries of destination, in net tons*¹
 [As reported by producers and wholesalers on Solid Fuels Administration for War form SFA-6]

Destination	Shipments of domestic sizes						Shipments of steam sizes and total shipments of all sizes							
	Broken	Egg	Stove	Chestnut	Pea	Total domestic sizes	Buck-wheat No. 1	Rice	Barley	Buck-wheat No. 4	All other sizes	Total steam sizes	Total all sizes	
													Net tons	Percent of total
United States:														
New England States:														
Connecticut.....	1,973	67,192	537,609	598,167	83,208	1,286,149	124,770	65,649	49,277	189	1	239,886	1,526,035	2.56
Maine.....		37,698	166,364	336,016	10,182	350,360	28,791	9,651			593	39,113	389,313	0.66
Massachusetts.....	4,143	431,146	1,301,256	798,375	115,715	2,638,635	106,449	116,456	55,842	19,467	3,780	392,033	3,060,648	5.14
New Hampshire.....	42	30,049	127,569	186,361	9,514	253,792	32,777	14,895	69,488	1,806	760	119,730	373,442	0.63
Rhode Island.....		44,061	199,398	188,693	24,423	416,455	40,312	13,851	1,716		711	56,060	472,575	0.79
Vermont.....	567	16,906	125,027	88,901	12,137	243,538	48,540	14,332	17,002			79,874	323,412	0.54
Total.....	6,725	647,052	2,457,260	1,852,513	255,179	5,218,729	471,633	234,834	192,903	21,492	5,864	926,716	6,145,445	10.32
Middle Atlantic States:														
New Jersey.....	10,071	166,568	1,358,652	2,517,106	926,185	4,978,585	1,167,794	793,771	1,272,639	448,736	105,425	3,788,365	8,796,950	14.72
New York.....	41,546	1,416,610	4,762,561	3,942,458	2,025,049	12,188,224	4,770,471	1,786,682	1,378,206	152,411	208,633	8,294,703	20,482,927	34.38
Pennsylvania:														
39,040	197,315	908,821	2,082,361	1,250,141	4,597,678	915,768	915,768	870,625	1,209,358	484,076	199,269	3,679,096	8,246,774	13.84
43,867	54,778	319,625	1,029,277	1,532,747	2,980,294	682,377	682,377	881,228	1,940,901	1,235,018	10,177	4,749,761	7,730,055	12.98
Excluding "local sales"														
"Local sales".....	82,907	252,093	1,318,446	3,111,638	2,792,888	7,547,972	1,598,145	1,751,853	3,160,319	1,719,094	209,446	8,428,857	15,978,829	26.82
Total Pennsylvania.....	134,527	1,835,271	7,439,659	9,571,202	5,734,122	24,714,781	7,536,410	4,332,306	5,801,164	2,320,241	521,804	20,511,925	45,226,706	75.92
Total Middle Atlantic.....														
South Atlantic States:														
Delaware.....	858	11,311	81,158	167,966	30,469	291,792	20,979	12,615	18,639	3,712	613	56,558	348,350	0.59
District of Columbia.....	294	42,343	94,721	95,374	22,716	257,448	37,011	3,254			145	40,410	297,858	0.50
Florida and Georgia.....		604	1,755	675	48	3,082					111	40,111	3,193	0.01
Maryland.....	2,492	74,807	287,046	242,388	78,016	684,749	146,104	13,862	27,613	290	17,631	205,430	890,249	1.49
North Carolina.....	30	50	918	1,604	26	2,628	261				270	270	3,061	0.01
South Carolina.....	1,500	2,408	80	5,195		5,195					95	31,711	5,465	0.01
Virginia.....	11,368	45,426	10,768	45,426	10,768	113,202	30,656	836	12		112	31,711	144,913	0.24
West Virginia.....	13	69	128			210					2,081	14,149	14,359	0.02
Total.....	3,674	141,996	515,725	554,798	142,113	1,358,306	235,011	30,617	46,294	16,115	21,135	349,142	1,707,448	2.87

North Central States:		12,401	64,304	210,520	10,745	298,026	2,935	14,809	3,931	9,277	20,911	60,870	348,803	70
Illinois	41	10,401	108,708	108,708	1,065	110,670	154	1,070	2,833	9,277	20,911	3,410	113,940	10
Iowa	224	1,434	1,045	1,045	1,065	10,750	52	1,174	50	100	72	459	17,227	103
Kansas and Missouri	56	2,219	5,254	5,254	1,234	6,327	314	44	107	2,277	8,400	8,774	18,201	103
Michigan	44	10,688	94,712	143,413	3,674	252,531	6,987	23,790	46,289	2,277	150	33,290	285,731	48
Minnesota	15	832	16,534	52,301	6,970	76,512	2,523	703	46,289	2,277	8,221	57,770	134,288	48
Nebraska	78	3,158	11,630	3,158	121	3,473	20	1,040	2,086	3,111	15,673	30,507	143,503	21
North Dakota	68	9,124	11,630	9,124	436	11,630	20	7,907	2,086	3,111	15,673	30,507	143,503	02
Ohio	702	8,357	10,361	92,946	540	112,995	1,040	7,907	2,086	3,111	15,673	30,507	143,503	02
South Dakota	17	1,354	16,885	531	18,787	35,591	78	1,934	1,934	34,902	34,902	72,427	420,808	03
Wisconsin	2,037	203,383	203,383	50,304	357,379	35,591	78	1,934	1,934	34,902	34,902	72,427	420,808	72
Total	1,002	38,752	286,479	856,797	74,708	1,257,786	49,718	50,554	9,303	61,043	97,528	268,146	1,525,944	2,56
South Central States:		93	32	374	40	539	113	128	14,694	130	14,952	15,491	15,491	02
Kentucky	606	606	33	29	40	539	113	128	14,694	130	14,952	15,491	15,491	01
All others	699	699	65	403	40	1,207	113	128	14,694	130	14,952	15,491	15,491	03
Total	15,334	15,334	133,541	258,049	214,932	622,456	77,397	47,585	20,170	8,622	177	162,774	785,230	668
Mountain and Pacific States		447	882	700	272	2,205	3,777	19,807	17	345	345	23,946	26,151	1,32
Unknown destinations	145,928	2,679,435	10,834,038	13,065,062	6,421,468	33,175,971	8,374,059	4,715,703	6,078,949	2,442,207	648,696	22,259,014	55,435,585	93,06
Total United States	145,928	2,679,435	10,834,038	13,065,062	6,421,468	33,175,971	8,374,059	4,715,703	6,078,949	2,442,207	648,696	22,259,014	55,435,585	93,06
Canada:		800	10,421	12,747	84	28,521	1,020	441	3,884	1,107	6,562	310,364	2,774,196	05
Provinces:	21,657	340,773	1,100,580	802,858	108,022	2,463,892	162,025	136,716	3,884	1,107	6,562	310,364	2,774,196	03
New Brunswick	147	122,939	428,128	204,202	39,414	794,890	212,451	175,756	62,057	56,578	977	506,849	1,301,739	4,66
Nova Scotia	42	8	2,588	2,797	60	5,495	2,239	1,020	441	1,107	6,562	310,364	2,774,196	2,18
Ontario	22,646	468,738	1,637,840	1,033,040	147,580	3,309,844	380,765	312,913	65,951	56,085	7,548	823,862	4,133,706	6,94
Quebec	168,574	3,148,193	12,472,312	14,120,337	6,569,048	30,467,464	8,754,824	5,028,616	6,144,900	2,408,892	656,300	23,083,532	59,570,990	100,00
All other Provinces	42	8	2,588	2,797	60	5,495	2,239	1,020	441	1,107	6,562	310,364	2,774,196	05
Total Canada	22,646	468,738	1,637,840	1,033,040	147,580	3,309,844	380,765	312,913	65,951	56,085	7,548	823,862	4,133,706	6,94
Other countries	168,574	3,148,193	12,472,312	14,120,337	6,569,048	30,467,464	8,754,824	5,028,616	6,144,900	2,408,892	656,300	23,083,532	59,570,990	100,00
Grand total	168,574	3,148,193	12,472,312	14,120,337	6,569,048	30,467,464	8,754,824	5,028,616	6,144,900	2,408,892	656,300	23,083,532	59,570,990	100,00

¹ Distribution data in this table and report are final. Preliminary statistics were published in the chapter Pennsylvania Anthracite, Minerals Yearbook, 1943, p. 954.
² Includes Alabama, Arkansas, Louisiana, Oklahoma, Tennessee, and Texas.
³ Includes California, Idaho, Montana, Nevada, Utah, Washington, and Wyoming.
⁴ Less than 0.005 percent.
⁵ Coal sold to over-the-road truckers for shipment outside the "local sales" area, and for which the destinations were not known.
⁶ Includes Alberta, British Columbia, Manitoba, Prince Edward Island, and Saskatchewan.

⁷ Shipments to final destinations in Canada reported by American and Canadian wholesalers were as listed—4,133,706 net tons. However the total of direct shipment by American wholesalers to final, Canadian destinations and to Canadian wholesalers was 4,396,116 net tons, distributed by sizes as 3,389,505 tons of Domestic, 511,694 tons of Buckwheat No. 1, 351 tons of Rice, and 132,081 tons of all other sizes. The difference is due principally to the incomplete reporting by Canadian wholesalers of shipments to final destinations. Official data from the U. S. Department of Commerce of total exports of anthracite to Canada were 4,429,973 net tons during the coal year 1942-43.

War in Report S. F. D. 1, Distribution of Pennsylvania Anthracite for the Coal Year April 1, 1942, to March 31, 1943. This report, listing shipments to separate destinations, contains the most nearly complete statistics ever released on anthracite distribution. These statistics were furnished by the producers and wholesalers of anthracite to the Bureau of Mines in compliance with Solid Fuels Administration for War Order 1, promulgated July 6, 1943, in initiating a distribution program that became necessary when it was apparent that unless the available supplies of anthracite were distributed equitably, serious local shortages might develop in the winter of 1943-44.

TABLE 6.—*Shipments of Pennsylvania anthracite, April 1, 1942–March 31, 1943, by method of movement, in net tons*

[As reported by producers and wholesalers on Solid Fuels Administration for War form SFA-6]

	Shipments of domestic sizes					
	Broken	Egg	Stove	Chestnut	Pea	Total domestic sizes
Shipments to retail dealers via:						
Rail.....	22,058	2,320,509	9,786,680	10,164,014	3,149,583	25,442,844
Tidewater.....	9,759	608,241	1,237,746	847,206	740,011	3,442,963
Lake.....		16,836	164,402	286,377	54,598	522,213
Truck ¹	5	57,210	821,205	1,554,387	854,682	3,287,489
Total retail dealers.....	31,822	3,002,796	12,010,033	12,851,984	4,798,874	32,695,509
All other shipments ²	92,885	90,268	141,772	247,376	237,155	809,456
Local sales ³	43,867	54,778	319,625	1,029,277	1,532,747	2,980,294
All other sales.....		351	882	700	272	2,205
Grand total.....	168,574	3,148,193	12,472,312	14,129,337	6,569,048	36,487,464

	Shipments of steam sizes and total shipments of all sizes						
	Buckwheat No. 1	Rice	Barley	Buckwheat No. 4	All other sizes	Total steam sizes	Total all sizes
							Net tons Percent of total
Shipments to retail dealers via:							
Rail.....	3,891,039	1,859,707	420,002	37,275	12,609	6,220,632	31,663,476 53.15
Tidewater.....	2,854,968	805,633	210,257	24,177	51	3,895,086	7,338,049 12.32
Lake.....	40,790	7,558	1,793	132	18,950	69,223	591,436 .99
Truck ¹	474,374	285,609	113,021	86,890		959,894	4,247,383 7.13
Total retail dealers.....	7,261,171	2,958,507	745,073	148,474	31,610	11,144,835	43,840,344 73.59
All other shipments ²	807,499	1,169,074	3,458,849	1,115,400	614,168	7,164,990	7,974,446 13.39
Local sales ³	682,377	881,228	1,940,961	1,235,018	10,177	4,749,761	7,730,055 12.98
All other sales.....	3,777	19,807	17		345	23,946	26,151 .04
Grand total.....	8,754,824	5,028,616	6,144,900	2,498,892	656,300	23,083,532	59,570,996 100.00

¹ Includes shipments from the mines to destinations outside the "local sales" area.

² Includes shipments to industrials, utilities, railroads, institutions, etc.; this tonnage was transported by all methods of movement and was not separable by type of carrier.

³ This tonnage was transported principally by truck.

As indicated in table 5, Pennsylvania anthracite was shipped to 43 States, the District of Columbia, Dominion of Canada, and other foreign countries. Of the total shipments, 86.3 percent was destined to the New England and Middle Atlantic States and 1.3 percent to "unknown destinations." Inasmuch as 784,270 tons of the total listed under "unknown destinations" were shipped from the mines by truck, it may be assumed that virtually all of this tonnage was

destined to New York, New Jersey, and Pennsylvania. Thus the shipments to the New England and Middle Atlantic States account for approximately 87.6 percent of the total anthracite shipped to destinations in the United States and Canada.

It will be noted in table 6 that, of the total tonnage shipped to retailers, 91 percent (39,956,680 tons) was Buckwheat No. 1 and larger sizes which are used almost entirely for heating homes, apartments, and hospitals and for other space-heating purposes. Of the anthracite shipped to retail dealers, 72 percent moved all-rail, 10 percent by truck, 17 percent by tide, and 1 percent off the Lake docks. The New England and Middle Atlantic States received 83 percent of all the shipments to retail dealers in the United States and Canada. Nearly all of the coal moving by tide was shipped from the New Jersey piers to the greater New York area, while a relatively small tonnage was shipped by water to the New England States.

TABLE 7.—*Shipments of Pennsylvania anthracite, 1942-44, by States of destination in net tons*¹

(Truck shipments excluded)

	1942	1943	1944
New England States.....	5,843,834	5,603,946	6,003,552
New York.....	17,107,566	17,812,425	16,821,928
New Jersey.....	9,215,932	8,632,278	9,465,559
Pennsylvania.....	10,154,459	10,528,699	11,693,186
Delaware.....	265,135	278,539	317,539
Maryland.....	746,568	760,497	905,993
District of Columbia.....	283,761	310,782	323,923
Virginia.....	126,779	108,764	147,013
Ohio.....	113,447	123,117	136,781
Indiana.....	98,242	93,215	85,124
Illinois.....	303,824	338,196	463,936
Wisconsin.....	394,328	460,020	392,616
Minnesota.....	67,416	179,647	146,857
Michigan.....	302,160	298,873	245,751
Other States.....	81,397	81,650	64,325
Total United States.....	45,134,848	45,612,648	47,214,163
Canada.....	3,730,722	3,600,508	3,675,870
Other foreign countries.....	6,528	15,711	5,118
Grand total.....	48,872,098	49,228,867	50,895,151

¹ Department of Mines, Harrisburg, Pa.

Anthracite shipments from the mine to destinations in the United States increased 3 percent in 1944 over 1943, according to data compiled from records of the Pennsylvania Department of Mines. Of the total 1944 shipments, 86 percent moved from the mines by rail and 14 percent by truck, whereas in 1943, 85 percent moved by rail and 15 percent by truck.

Pennsylvania received 78 percent of the truck shipments in 1944; New Jersey and New York followed with 10 percent and 9 percent, respectively. It is interesting to compare these percentages with those of 1941, when Pennsylvania received 66 percent of the total truck shipments, New Jersey 18 percent, and New York 14 percent. This shift in the quantity of anthracite trucked to these States is no doubt a direct result of wartime shortages of gasoline, tires, and other truck equipment. Anthracite rail shipments by States of destination for 1942-44 are shown in table 7, and truck movement in 1944, by months, by States of destination, in table 8.

According to data compiled from the records of the Massachusetts Division on the Necessaries of Life and the Anthracite Emergency Tidewater Bureau, rail receipts of Pennsylvania anthracite in New England increased 10 percent over 1943; tidewater receipts declined 6 percent. Table 9 gives details of anthracite movement to New England. Loadings at Lake Erie ports increased 61 percent and receipts at upper Lake docks 89 percent over 1943. The big increases in the Great Lakes region are due largely to the increased use of the smaller steam sizes of anthracite by briquet manufacturers.

Figure 1 presents graphically shipments of anthracite from the Lehigh, Schuylkill, and Wyoming regions, 1850 to 1944, inclusive.

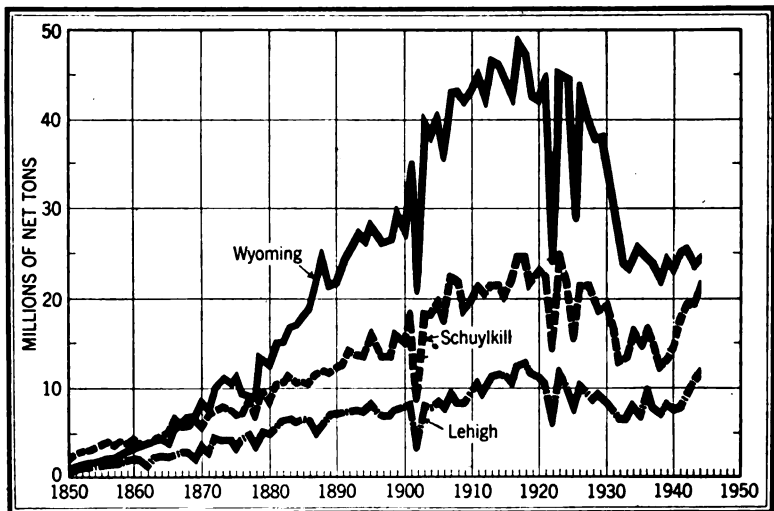


FIGURE 1.—Anthracite shipped from the Lehigh, Schuylkill, and Wyoming regions, 1850-1944.

Consumption.—Consumption of anthracite in the United States in 1944, including colliery fuel and coal dredged from the streams draining the anthracite fields, totaled 59,400,000 tons, an increase of 4 percent over the calculated consumption in 1943. These data consider exports, imports, and changes in producer stocks of anthracite but do not consider changes in stocks held by retail dealers, as data on stocks held by this group are incomplete. Consumption of anthracite in the manufacture of fuel briquets increased from 388,693 net tons in 1943 to 711,109 tons in 1944; the gain was caused largely by a shortage of low-volatile bituminous coal generally used extensively in making briquets. Consumption of anthracite by electric power utilities increased 5 percent over 1943, whereas consumption by class I railroads declined 9 percent.

Changes in stocks.—Because of the great demand for anthracite for comfort heating in 1944, there were virtually no Domestic and Buckwheat No. 1 sizes in producers' storage during the year. Almost all of the coal in storage at the close of the year was Buckwheat No. 3 and smaller. Stocks held by railroads (class I only) increased 35 percent in 1944 over 1943, whereas stocks held by electric power utilities declined 8 percent, and stocks on the upper Lake docks

increased 105 percent. In January, retail dealers held an 11 days' supply of anthracite; in March, 9 days'; and at the close of the year, 19 days'.

TABLE 8.—Truck shipments of Pennsylvania anthracite by months in 1944, by States of destination, in net tons ¹

Destination	January	February	March	April	May	June	July
Pennsylvania:							
Within region.....	407, 115	397, 343	445, 950	328, 734	266, 782	276, 694	235, 363
Outside region.....	143, 400	120, 291	180, 732	139, 358	151, 300	177, 209	156, 726
New York.....	51, 002	64, 102	50, 777	54, 884	52, 099	50, 022	52, 519
New Jersey.....	58, 754	73, 506	83, 922	69, 486	64, 439	64, 152	60, 094
Maryland.....	7, 973	7, 985	7, 023	5, 931	6, 791	13, 224	5, 147
Delaware.....	6, 326	5, 867	4, 111	4, 221	4, 823	4, 584	4, 450
District of Columbia.....						231	
Other States.....	1, 803	1, 578	1, 607	1, 589	1, 271	1, 972	8, 648
Total: 1944.....	676, 373	670, 672	780, 122	604, 203	547, 505	597, 388	522, 947
1943.....	679, 233	785, 646	796, 933	718, 094	651, 895	392, 140	628, 124

Destination	August	September	October	November	December	Total	Percent of total trucked
Pennsylvania:							
Within region.....	311, 395	336, 487	356, 054	341, 347	397, 542	4, 100, 806	53.2
Outside region.....	176, 585	178, 341	194, 854	185, 372	145, 676	1, 949, 844	25.3
New York.....	57, 901	58, 151	66, 950	62, 606	41, 414	667, 427	8.7
New Jersey.....	61, 058	68, 125	69, 259	67, 250	48, 230	788, 275	10.2
Maryland.....	13, 224	7, 082	17, 863	12, 586	5, 652	110, 481	1.4
Delaware.....	5, 274	5, 121	6, 210	5, 982	5, 352	62, 621	.8
District of Columbia.....		125	159	159	17	691	(?)
Other States.....	1, 424	7, 881	1, 917	1, 851	1, 292	32, 833	.4
Total: 1944.....	626, 861	661, 313	713, 266	667, 153	645, 175	7, 712, 978	100.0
1943.....	684, 302	723, 089	627, 847	439, 143	751, 414	7, 877, 860	100.0

¹ Compiled from reports of Pennsylvania Department of Mines.

² Less than 0.01 percent.

TABLE 9.—Receipts of anthracite in New England, 1917, 1920, 1923, and 1927-44 in thousands of net tons

Year	Receipts by tide ¹						Receipts by rail ¹	Imports ²	Total receipts of Pennsylvania anthracite ³
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total			
1917.....	432	47	2, 222	555	1, 165	4, 421	7, 259	1	11, 679
1920.....	307	6	2, 015	450	743	3, 521	7, 804	1	11, 324
1923.....	437	27	2, 216	511	891	4, 082	8, 102	145	12, 039
1927.....	242	33	1, 220	311	615	2, 421	6, 725	106	9, 040
1928.....	205	35	1, 373	301	528	2, 442	6, 934	369	9, 007
1929.....	237	17	1, 227	329	450	2, 260	6, 781	483	8, 558
1930.....	275	17	1, 236	271	422	2, 221	6, 169	658	7, 732
1931.....	164	18	1, 125	282	348	1, 937	5, 125	611	6, 451
1932.....	148	10	1, 014	212	275	1, 659	3, 980	574	5, 065
1933.....	195	7	1, 027	202	259	1, 690	3, 562	443	4, 809
1934.....	168	20	946	190	266	1, 590	4, 382	477	5, 495
1935.....	121	7	802	205	237	1, 372	4, 030	559	4, 843
1936.....	127	14	792	198	267	1, 398	3, 889	612	4, 675
1937.....	81	11	604	152	200	1, 048	3, 713	395	4, 366
1938.....	93	2	554	137	191	977	3, 491	363	4, 105
1939.....	74	3	488	83	227	875	4, 027	298	4, 604
1940.....	48	4	350	74	172	648	4, 174	135	4, 687
1941.....	57	9	348	58	210	682	4, 870	75	5, 477
1942.....	Not available.....						581	139	5, 835
1943.....							575	164	5, 721
1944.....							398	12	6, 222

¹ Commonwealth of Massachusetts, Division on the Necessaries of Life.

² U. S. Department of Commerce.

³ Total receipts by rail and by tide less imports.

"Bootleg" coal.—The seventh survey of "bootleg" anthracite mining by the Anthracite Committee in March 1945 revealed that 502 "bootleg" holes were being worked by 1,806 men, a substantial drop from the 10,762 men working 3,006 holes, disclosed by the March 1941 survey. A survey by the Committee in May 1942 revealed that 55 percent of the men and boys working in "bootleg" holes were less than 35 years old. A comparable survey in March 1945 indicated that only 37 percent were in this younger group. A large percentage of these younger men had either entered the armed forces or transferred to some war industry. Output of "bootleg" coal totaled 1,333,000 net tons in 1944 compared with 1,912,000 tons in 1943.

In February 1945 a bill was introduced before the Pennsylvania General Assembly giving State mine inspectors authority to enter and inspect any mining operation where two or more men are employed. If passed, this law might bring about virtual cessation of "bootleg" operations, since these mines would have difficulty in meeting the rigid inspection standards of the Pennsylvania State Department of Mines. The present law requires periodic inspection only of those mines employing five or more men. A detailed discussion of "bootleg coal" is contained in a report entitled, "Bootlegging or Illegal Mining of Anthracite Coal in Pennsylvania," Anthracite Coal Industry Commission, Commonwealth of Pennsylvania, Harrisburg, Pa., 1937, 84 pages.

Trend in employment.—The decline in employment from 82,121 men in 1942 to 77,591 in 1944, occurring chiefly among underground miners and their laborers, has been due principally to the induction of men into the armed forces and the loss of others to nearby war industries. These figures do not include men working in "bootleg" holes; for employment in this type of mining, see discussion of "bootleg coal" in this chapter. Data on employment are given in tables 23 and 24.

Sales realization.—To compensate the producers for added production costs incurred in wage agreements with the mine workers, the Office of Price Administration authorized increases in the f. o. b. mine prices of anthracite in November 1943. These increases, together with price advances in February, were reflected in the 1944 prices, thereby increasing the average sales realization on breaker shipments from \$5.38 in 1943 to \$5.91 in 1944. The average value per ton of the total anthracite output was \$5.57, compared with \$5.06 in 1943.

Trend in prices.—The Solid Fuels Administrator for War directed the Federal operating managers of the anthracite mines to give the miners an opportunity to work four Sundays in February to increase the output of anthracite. To compensate the producers for added costs of production due to the Sunday work, the Office of Price Administration authorized an increase of 45 cents a net ton in the f. o. b. mine prices of anthracite for all coal loaded at the preparation plants for shipment during February. The maximum prices before the February increase were: Broken, Egg, Stove, and Chestnut, \$8.00; Pea, \$6.45; Buckwheat No. 1, \$4.80; Rice, \$3.85; and Barley, \$2.85 a net ton, respectively. On March 1 the mine prices reverted to these quotations.

On June 1 the f. o. b. mine prices were decreased an average of 14 cents a ton by order of the Office of Price Administration. That agency stated that the increase of 62 cents a ton, granted the pro-

TABLE 10.—*Reduct prices of selected fuels in 1944, by cities and months*
[Coal and coke are per net ton and heating oil per 100 gallons]

PENNSYLVANIA ANTHRACITE

925

City and fuel	January	February	March	April	May	June	July	August	September	October	November	December
Baltimore, Md.												
Anthracite:												
Stove	\$13.29	\$13.74	\$13.35	\$13.35	\$13.35	\$13.22	\$13.22	\$13.22	\$13.22	\$13.22	\$13.22	\$13.22
Buckwheat No. 1	10.34	10.73	10.40	10.40	10.40	10.18	10.18	10.18	10.18	10.18	10.18	10.18
Bituminous coal, low-volatile stove	10.79	10.79	10.79	10.79	10.79	10.87	10.87	10.87	10.87	10.87	10.87	10.87
Coke, egg	(2)	(1)	(1)	(2)	(2)	(1)	(1)	(1)	(2)	(1)	(1)	(1)
Heating oil:												
Fuel oil No. 2	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Fuel oil No. 3												
Boston, Mass.												
Anthracite:												
Stove	15.79	16.24	15.79	15.79	15.79	15.64	15.64	15.64	15.64	15.64	15.64	15.64
Buckwheat No. 1	12.09	12.54	12.09	12.09	12.09	11.94	11.94	11.94	11.94	11.94	11.94	11.94
Bituminous coal, low-volatile stove	14.29	14.79	14.79	14.79	14.79	14.79	14.79	14.79	14.79	14.79	14.79	14.99
Coke, egg												
Heating oil:												
Fuel oil No. 2	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Fuel oil No. 3	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Buffalo, N. Y.												
Anthracite:												
Stove	13.67	14.12	13.67	13.67	13.67	13.62	13.62	13.62	13.62	13.62	13.62	13.62
Buckwheat No. 1	9.82	10.27	9.82	9.82	9.82	9.68	9.68	9.68	9.68	9.68	9.68	9.68
Bituminous coal, low-volatile stove	10.89	11.29	11.29	11.29	11.29	11.29	11.29	11.24	11.24	11.24	11.24	11.24
Coke, egg												
Heating oil:												
Fuel oil No. 2	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	9.50	9.50	9.50	9.50
Fuel oil No. 3	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	9.50	9.50	9.50	9.50
Chicago, Ill.												
Anthracite:												
Stove	16.97	17.30	17.05	17.02	16.98	16.86	16.84	16.84	16.84	16.84	16.84	16.84
Buckwheat No. 1	13.64	14.02	13.64	13.64	13.64	13.62	13.49	13.49	13.49	13.49	13.49	13.49
Bituminous coal, low-volatile stove	12.47	12.47	12.47	12.47	12.47	12.48	12.55	12.55	12.55	12.57	12.57	12.57
Coke, egg	15.09	15.09	15.09	15.09	15.09	15.09	15.09	15.09	15.09	15.09	15.09	15.09
Heating oil:												
Fuel oil No. 2	7.96	7.96	7.96	7.96	7.96	7.96	7.76	7.45	7.45	7.45	7.45	7.45
Fuel oil No. 3	7.96	7.96	7.96	7.96	7.96	7.96	7.70	7.45	7.45	7.45	7.45	7.45
Milwaukee, Wis.												
Anthracite:												
Stove	15.43	15.78	15.51	15.51	15.51	15.36	15.36	15.36	15.36	15.36	15.36	15.46
Buckwheat No. 1	12.23	12.32	12.32	12.32	12.32	12.16	12.16	12.16	12.16	12.16	12.16	12.16
Bituminous coal, low-volatile stove	12.92	12.92	12.92	13.06	13.17	13.17	13.17	13.17	13.17	13.17	13.17	13.27
Coke, egg	13.67	13.69	13.69	13.69	13.69	13.69	13.62	13.62	13.62	13.62	13.62	13.71
Heating oil:												
Fuel oil No. 2	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Fuel oil No. 3	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00

See footnotes at end of table.

TABLE 10.—*Retail prices of selected fuels in 1944, by cities and months*—Continued

City and fuel	January	February	March	April	May	June	July	August	September	October	November	December
New York, N. Y. ¹												
Anthracite:												
Stove	\$14.13	\$14.62	\$14.12	\$14.12	\$14.12	\$13.97	\$13.97	\$13.97	\$13.97	\$13.97	\$13.97	\$13.97
Buckwheat No. 1	9.90	10.41	9.97	9.97	9.97	9.81	9.81	9.81	9.81	9.81	9.81	9.81
Bituminous coal, low-volatile stove												
Coke, egg	13.22	14.02	14.02	14.02	14.02	14.02	14.84	14.84	15.07	14.74	14.73	14.73
Heating oil:												
Fuel oil No. 2	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09
Fuel oil No. 3	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09	9.09
Philadelphia, Pa.												
Anthracite:												
Stove	13.04	13.49	13.40	13.42	13.09	13.08	13.09	13.08	13.08	13.11	13.11	13.12
Buckwheat No. 1	9.59	10.04	9.95	9.97	9.64	9.63	9.64	9.63	9.63	9.62	9.63	9.64
Bituminous coal, low-volatile stove												
Coke, egg	11.79	12.29	12.65	12.52	12.29	12.29	12.29	12.40	12.78	12.82	12.82	12.82
Heating oil:												
Fuel oil No. 2	8.98	8.98	8.95	8.95	8.95	8.95	8.93	8.93	8.93	8.93	8.93	8.93
Fuel oil No. 3	8.97	8.97	8.94	8.94	8.94	8.94	8.91	8.91	8.91	8.91	8.91	8.91
Portland, Maine.												
Anthracite:												
Stove	15.78	16.23	15.78	15.78	15.78	15.63	15.63	15.63	15.63	15.63	15.63	15.63
Buckwheat No. 1	11.83	12.28	11.83	11.83	11.83	11.68	11.68	11.68	11.68	11.68	11.68	11.68
Bituminous coal, low-volatile stove												
Coke, egg	14.19	14.68	14.68	14.68	14.68	14.68	14.68	14.68	14.68	14.68	14.78	14.83
Heating oil:												
Fuel oil No. 2	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Fuel oil No. 3												
Washington, D. C. ¹												
Anthracite:												
Stove	15.15	15.64	15.15	15.15	15.15	14.95	14.95	14.95	14.95	14.95	14.95	14.95
Buckwheat No. 1	11.19	11.69	11.19	11.19	11.19	10.99	10.99	11.05	11.05	11.05	11.05	11.05
Bituminous coal, low-volatile stove												
Coke, egg	13.04	13.54	13.42	13.42	13.42	13.54	13.54	13.54	13.54	13.54	13.54	13.54
Heating oil:												
Fuel oil No. 2	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40
Fuel oil No. 3												

¹ Compiled from reports of the Bureau of Labor Statistics, U. S. Department of Labor.

Prices are as of 15th of each month. Data are preliminary.

* Insufficient data.

* Includes 2 percent sales tax.

* Includes 1 percent sales tax.

* Prices of coal per ton of 2,240 pounds.

ducers in November 1943 to compensate for increased labor costs allowable under the "Little Steel Formula" and wage agreement of November 3, contained an additional 14 cents to compensate for added labor costs made retroactive to May 1, 1943, by the War Labor Board. Hence on June 1, and at the close of the year the mine prices were as follows: Broken, Egg, Stove, and Chestnut, \$7.85; Pea, \$6.30; Buckwheat No. 1, \$4.65; Rice, \$3.75; and Barley, \$2.75 a ton, respectively.

Retail prices of anthracite, bituminous coal, coke, and heating oils in selected cities, by months, in 1944 are shown in table 10. These prices were compiled from reports of the Bureau of Labor Statistics, United States Department of Labor.

Imports and exports.—Exports of anthracite, 99 percent of which was destined to Canada, increased 1 percent in 1944 over 1943. Imports were negligible totaling only 11,847 tons, a decline of 93 percent from the tonnage imported in 1943. For details on imports and exports see tables 31 and 32.

Mechanical stokers and oil burners.—Government restrictions on the manufacture and sale of stokers and oil burners have been largely responsible for the general decline in shipments of this equipment since 1941. According to the Bureau of the Census, United States Department of Commerce, factory sales of class 1 mechanical stokers for burning anthracite (capacity under 61 pounds of coal per hour) declined from 17,110 units in 1941 to 472 units in 1943 and in 1944 totaled only 450 units. Sales of class 2 stokers (capacity 61 to 100 pounds of anthracite per hour) were 599 units in 1941 and increased to 2,043 units in 1943 and to 2,243 units in 1944. Shipments of oil burners for central heating plants and industrial use totaled 303,869 units in 1941, declined to 72,563 units in 1943, and increased to 77,081 units in 1944.

POSTWAR OUTLOOK

The relative position of the anthracite industry in the highly competitive fuel markets in the Eastern States during the postwar period will depend largely on intensive research and experimental work now and after the war to reduce the cost of mining anthracite and to develop new, low-cost, automatic coal-burning equipment. With the tremendous home-building program that is expected to get under way immediately after the war, the installation of such equipment would play an important part in the retention of customers gained during the war and the addition of new ones. Competition among anthracite, oil, coke, and bituminous coal will be extremely keen in the postwar markets, and to prevent a sharp decline in sales of anthracite it will be necessary for the industry to initiate concentrated marketing and merchandizing programs and for industry associations to cooperate closely with architects, builders, and manufacturers of heating equipment. (See subheadings, Research and Anthracite Industries, Inc.)

SOURCES AND ACKNOWLEDGMENTS

Annual statistics of the Pennsylvania anthracite industry are prepared, for the most part, from reports received direct from the producers and shippers of anthracite, as a result of a canvass con-

ducted by mail. More than 95 percent of the tonnage is reported in this manner, and the remainder is obtained personally by a representative of the Bureau of Mines or from reliable collateral evidence. The information is furnished voluntarily by the producers and is held confidential, as is customary with the statistical services of the Bureau of Mines.

In compiling available information, pertinent statistics prepared by the Pennsylvania Department of Mines, the Anthracite Committee, the Anthracite Institute, and the Association of American Railroads have been used to advantage. The Bureau of Mines gratefully acknowledges the cooperation of these organizations and others from whom information has been received.

PRODUCTION

Production of Pennsylvania anthracite in 1944 totaled 63,701,363 net tons, an increase of 5 percent over the output of 60,643,620 tons in 1943. These statistics include deep-mined and strip-pit production, coal recovered from the culm banks, anthracite purchased by the industry from "bootleggers", and river or creek coal recovered from the streams draining the anthracite fields by dredging. Also included is a small tonnage of semianthracite (147,217 tons in 1944) produced in Sullivan County. In addition to the production of 63,701,363 net tons, the industry shipped 507,590 tons of slush, that is, the settlings from the water used in cleaning anthracite. The marketing of this material, a necessity occasioned by the shortage of coal during the winter of 1944-45, probably will be discontinued in the postwar period. As the coal was generally unprepared, the average value received for it was only about 30 cents per ton compared with \$1.67 a ton for the Buckwheat No. 4 size. This material was excluded from the production statistics to avoid distortion of values, shipments, and output per man per day and to keep the data comparable with those of previous years. See tables 13 to 19 for production and shipments by regions, fields, and counties.

Before 1930 anthracite was produced only by companies who owned or leased the coal lands. During the depression in the early 1930's, unemployed miners commenced to mine anthracite in the Lehigh and Schuylkill regions from lands of the operating companies without permission of the owners, transporting the coal to market by truck. Before 1941 this coal, generally referred to as "bootleg coal," was not included in the production statistics of the Pennsylvania anthracite industry by the Bureau of Mines. In 1941, however, the anthracite industry started to purchase run-of-mine coal from the so-called "bootleggers" for preparation and shipment to market. In 1943 these purchases totaled 1,265,617 net tons; in 1944, 506,842 tons. Since it has been ruled impractical to segregate this purchased anthracite from the output of the industry proper, it is included in the various production tables in the Minerals Yearbook chapters on Pennsylvania anthracite for 1941-44. As a result, the production statistics for the last 5 years are not exactly comparable with those of previous years. To compute the output per man per day for the anthracite industry, it was necessary to deduct the "bootleg" purchases from the total tonnage shipped by the legitimate industry because adequate data on man-days required to produce this tonnage are not available.

Details on this procedure are discussed under Labor Statistics. "Bootleg" coal is discussed under the subheading "Bootleg" Coal.

Weeks and months.—Tables 11 and 12 summarize statistics of weekly and monthly production of anthracite. Data of current output are estimated from records of carloadings and from tonnage reports from trade sources. The weekly and monthly figures have been adjusted to the annual total ascertained by direct canvass of the operators.

Small mines and intercompany sales.—In recent years conditions have favored the development of numerous small mines operating on lease or subcontract and producing run-of-mine coal, which is sold to larger companies for preparation at a breaker. (This refers to legitimate mines only and does not concern illicit or "bootleg" mines.)

TABLE 11.—*Estimated weekly production of Pennsylvania anthracite in 1944*

Week ended—	Net tons	Week ended—	Net tons
Jan. 1.....	1 10,000	July 15.....	1 236,000
8.....	1,094,000	22.....	1 193,000
15.....	1,166,000	29.....	1 223,000
22.....	1 239,000	Aug. 5.....	1 207,000
29.....	1 259,000	12.....	1 232,000
Feb. 5.....	1 249,000	19.....	1 162,000
12.....	1 408,000	26.....	1 282,000
19.....	1 415,000	Sept. 2.....	1 301,000
26.....	1 330,000	9.....	1 130,000
Mar. 4.....	1 388,000	16.....	1 248,000
11.....	1 236,000	23.....	1 267,000
18.....	1 217,000	30.....	1 321,000
25.....	1 209,000	Oct. 7.....	1 231,000
Apr. 1.....	1 270,000	14.....	1 303,000
8.....	1 115,000	21.....	1 270,000
15.....	1 194,000	28.....	1 304,000
22.....	1 307,000	Nov. 4.....	1 125,000
29.....	1 328,000	11.....	1 145,000
May 6.....	1 263,000	18.....	1 234,000
13.....	1 311,000	25.....	1 122,000
20.....	1 290,000	Dec. 2.....	1 179,000
27.....	1 353,000	9.....	1 127,000
June 3.....	1 190,000	16.....	1 155,000
10.....	1 311,000	23.....	1 115,000
17.....	1 304,000	30.....	775,000
24.....	1 225,000		
July 1.....	1 272,000	Calendar year.....	63,701,000
8.....	861,000		

¹ Figures represent output of working days in that part of week included in calendar year 1944. Revised total for Jan. 1, 1944, was 896,000 tons.

TABLE 12.—*Estimated monthly production of Pennsylvania anthracite, 1937-44, in thousands of net tons*¹

Month	1937	1938	1939	1940	1941 ²	1942 ²	1943 ²	1944 ²
January.....	4,236	4,978	5,019	5,783	5,162	4,560	4,466	4,970
February.....	3,671	3,646	4,169	3,648	4,506	4,801	5,203	5,811
March.....	4,795	4,257	3,652	3,881	4,765	5,116	5,855	5,512
April.....	6,779	3,149	5,367	3,853	3,317	5,185	5,337	5,141
May.....	4,361	4,400	5,141	4,070	4,001	4,873	5,219	5,781
June.....	4,635	4,450	3,577	4,492	5,072	5,153	3,244	5,558
July.....	2,748	2,580	2,951	4,534	4,855	5,374	5,698	4,905
August.....	2,903	2,735	3,883	3,883	5,441	5,212	5,653	5,558
September.....	3,682	3,388	4,840	4,172	5,334	5,459	5,474	5,380
October.....	4,848	4,180	4,985	4,355	5,580	5,132	5,350	5,538
November.....	4,439	3,803	3,989	3,980	3,974	4,824	4,140	5,029
December.....	4,759	4,533	3,914	4,834	4,271	4,639	4,996	4,518
	51,856	46,099	51,487	51,485	56,368	60,328	60,644	63,701

¹ Production is estimated from weekly carloadings as reported by the Association of American Railroads and includes mine fuel, coal sold locally, and dredge coal.

² Includes some "bootleg" coal purchased by legitimate operators and prepared at their breakers.

At the same time, an increasing transfer of coal from one operation to another has developed, and some of the companies have built central breakers to which coal from numerous mines is shipped by rail or truck for preparation. These developments have increased the complexity of the task of collecting and compiling statistics of the industry. Great care has been exercised, however, to avoid double counting of tonnages produced by one operator and prepared for market by another, and the figures herein represent the net quantity of merchantable coal plus the fuel used by the collieries themselves. The employees of operators producing run-of-mine coal only have been included in the employment statistics, as they have received wages from the industry and have contributed to the final product.

Regions, fields, and counties.—The anthracite fields are divided into three trade regions—Lehigh, Schuylkill, and Wyoming. This classification is generally used by the trade, and it is also followed in the district organization of the United Mine Workers of America, in which district 1 corresponds to the Wyoming region, district 7 to the Lehigh region, and district 9 to the Schuylkill region. Geologically the anthracite area is classified by fields—the Northern, Eastern Middle,

TABLE 13.—*Pennsylvania anthracite produced, 1940–44, by fields, in net tons*

[The figures of breaker product includes a certain quantity of culm-bank coal, which amounted to 6,128,452 tons in 1944]

Field	1940	1941	1942	1943	1944
Eastern Middle:					
Breakers.....	1 5,104,708	5,066,892	5,717,908	6,140,224	5,905,623
Washeries.....	(1)	217,642	259,378	356,450	403,688
Dredges.....		5,032			
Total Eastern Middle.....	5,104,708	5,289,566	5,977,286	6,496,674	6,309,311
Western Middle:					
Breakers.....	10,168,142	11,531,105	13,122,774	12,577,769	12,721,704
Washeries.....	734,541	946,794	333,089	280,525	538,875
Dredges.....	447,760	531,129	466,339	442,608	385,137
Total Western Middle.....	11,350,443	13,009,028	13,922,202	13,300,902	13,645,716
Southern:					
Breakers.....	6,615,347	7,445,528	8,797,539	10,519,946	12,194,069
Washeries.....	812,162	1,116,438	1,326,087	1,486,803	2,091,473
Dredges.....	492,684	973,457	794,627	879,379	983,046
Total Southern.....	7,920,193	9,537,423	10,918,253	12,886,128	15,268,588
Northern:					
Breakers.....	26,571,383	28,097,833	29,269,471	1 27,417,425	27,794,631
Washeries.....	484,569	391,452	168,237	1 432,021	531,336
Dredges.....	2,500	5,945	24,067	12,750	4,55
Total Northern.....	27,058,452	28,495,230	29,461,775	27,862,196	28,330,53
Total, excluding Sullivan County:					
Breakers.....	1 48,459,580	52,141,358	56,907,692	1 56,655,364	58,616,03
Washeries.....	1 2,031,272	2,672,326	2,086,791	1 2,555,799	3,565,37
Dredges.....	942,944	1,517,563	1,285,033	1,334,737	1,372,72
Total.....	51,433,796	56,331,247	60,279,516	60,545,900	63,554,1
Sullivan County: Breakers.....	50,844	37,020	48,213	97,720	147,2
Grand total.....	51,484,640	56,368,267	60,327,729	60,643,620	63,701,3

1 Small quantity of washery coal included with breaker.

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Western Middle, and Southern. This classification is based on operating studies because it follows more closely the geological conditions that largely influence the methods and costs of production. The Northern field is the same as the Western Middle field and that part of the Southern field known as the Panther Creek Valley. The Southern field, including the Schuykill region comprises that part of the Western Middle west of Tamaqua and the Western Middle east of Tamaqua. In comparison, the tonnage of the small Berks field is about equal to the statistics of the Northern field. The Schuylkill field is classified officially as semianthracite. The total area of the Schuylkill field is 484 square miles—the Northern covers 242, the Southern 242. Middle 33, the Western Middle 94, and the Southern 146. Based upon minable reserves, the Southern field is the largest, followed by the Western Middle, Northern, and Eastern. The Eastern field is the smallest. Tables 13 to 19 present production statistics for the various counties.

TABLE 14.—*Penyslvania anthracite shirvel fuel in 1944*

[illegible]

in net tons

	Total
000	764,000
000	1,076,000
4,000	2,648,000
08,000	5,028,000
700,000	6,128,000

Culm-bank coal.—The record production from culm banks in 1944 comprised 15 percent of the total anthracite output. In the early days of anthracite mining the smaller sizes of anthracite, especially Pea and under, were not used as they are today, and these sizes and larger pieces of refuse containing much good coal were piled in banks throughout the region. With the current heavy demand for anthracite, the recoverable coal in the culm banks is being rapidly depleted, and it is doubtful whether the production attained in 1944 from this source can be maintained for more than a few years. Tables 17 and 19 give details on culm-bank output.

Interregional variation in sizes.—Because of geological conditions and mining methods used, the percentage yield of domestic sizes of anthracite is greater in the Wyoming region than in either the Lehigh or Schuylkill. The breaker output of domestic sizes declined from 65.9 percent in 1940 to 62.8 percent in 1944, whereas the steam sizes increased from 34.1 to 37.2 percent. The decline in the percentage of domestic sizes and the gain in the steam sizes during this period are due principally to large proportionate gains in the output of culm-bank coal, which yields a large percentage of steam sizes. Table 20 shows, by regions, the percentage of sizes in relation to total breaker output.

TABLE 15.—*Pennsylvania anthracite produced in 1944, classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product by regions, in net tons*

Region and type of plant	From mines			From culm banks	From river dredging	Total
	Underground		Strip pits			
	Mechani- cally loaded	Hand- loaded				
Lehigh:						
Breakers	945, 967	6, 753, 889	2, 305, 741	1, 722, 727	-----	11, 728, 324
Washeries	-----	-----	21, 567	402, 590	-----	424, 157
Dredges	-----	-----	-----	-----	40, 894	40, 894
Total Lehigh	945, 967	6, 753, 889	2, 327, 308	2, 125, 317	40, 894	12, 193, 375
Schuylkill:						
Breakers	1, 652, 467	7, 300, 399	6, 890, 970	3, 249, 236	-----	19, 093, 072
Washeries	-----	2, 717	69, 362	2, 537, 800	-----	2, 609, 879
Dredges	-----	-----	-----	-----	1, 327, 289	1, 327, 289
Total Schuylkill	1, 652, 467	7, 303, 116	6, 960, 332	5, 787, 036	1, 327, 289	23, 030, 240
Wyoming:						
Breakers	12, 376, 712	12, 623, 361	1, 651, 910	1, 142, 656	-----	27, 794, 639
Washeries	-----	-----	-----	531, 338	-----	531, 338
Dredges	-----	-----	-----	-----	4, 554	4, 554
Total Wyoming	12, 376, 712	12, 623, 361	1, 651, 910	1, 673, 994	4, 554	28, 330, 531
Total, excluding Sullivan County:						
Breakers	14, 975, 146	26, 677, 649	10, 848, 621	6, 114, 619	-----	58, 616, 035
Washeries	-----	2, 717	90, 929	3, 471, 728	-----	3, 565, 374
Dredges	-----	-----	-----	-----	1, 372, 737	1, 372, 737
Total	14, 975, 146	26, 680, 366	10, 939, 550	9, 586, 347	1, 372, 737	63, 554, 146
Sullivan County: Breakers	-----	119, 904	13, 480	13, 833	-----	147, 217
Grand total	14, 975, 146	26, 800, 270	10, 953, 030	9, 600, 180	1, 372, 737	63, 701, 363

TABLE 16.—*Pennsylvania anthracite produced in 1944, classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, by fields, in net tons*

Field and type of plant	From mines			From culm banks	From river dredging	Total
	Underground		Strip pits			
	Mechani- cally loaded	Hand- loaded				
Eastern Middle:						
Breakers.....	945, 967	3, 132, 783	1, 083, 006	743, 867	-----	5, 905, 623
Washeries.....	-----	-----	21, 567	382, 121	-----	403, 688
Dredges.....	-----	-----	-----	-----	-----	-----
Total Eastern Middle.....	945, 967	3, 132, 783	1, 104, 573	1, 125, 988	-----	6, 309, 311
Western Middle:						
Breakers.....	1, 451, 877	5, 568, 130	3, 173, 476	2, 528, 221	-----	12, 721, 704
Washeries.....	-----	-----	-----	538, 876	-----	538, 876
Dredges.....	-----	-----	-----	-----	385, 137	385, 137
Total Western Middle.....	1, 451, 877	5, 568, 130	3, 173, 476	3, 067, 096	385, 137	13, 645, 716
Southern:						
Breakers.....	200, 590	5, 353, 375	4, 940, 229	1, 699, 875	-----	12, 194, 099
Washeries.....	-----	2, 717	60, 362	2, 019, 394	-----	2, 081, 473
Dredges.....	-----	-----	-----	-----	983, 046	983, 046
Total Southern.....	200, 590	5, 356, 092	5, 009, 591	3, 719, 269	983, 046	15, 268, 588
Northern:						
Breakers.....	12, 376, 712	12, 623, 361	1, 651, 910	1, 142, 656	-----	27, 794, 639
Washeries.....	-----	-----	-----	531, 338	-----	531, 338
Dredges.....	-----	-----	-----	-----	4, 554	4, 554
Total Northern.....	12, 376, 712	12, 623, 361	1, 651, 910	1, 673, 994	4, 554	28, 330, 531
Total, excluding Sullivan County:						
Breakers.....	14, 975, 146	26, 677, 649	10, 848, 621	6, 114, 619	-----	58, 616, 035
Washeries.....	-----	2, 717	90, 929	3, 471, 728	-----	3, 565, 374
Dredges.....	-----	-----	-----	-----	1, 372, 737	1, 372, 737
Total.....	14, 975, 146	26, 680, 366	10, 939, 550	9, 586, 347	1, 372, 737	63, 554, 146
Sullivan County: Breakers.....	-----	119, 904	13, 480	13, 833	-----	147, 217
Grand total.....	14, 975, 146	26, 800, 270	10, 953, 030	9, 600, 180	1, 372, 737	63, 701, 363

TABLE 17.—*Culm-bank coal put through breakers, 1940-44, by fields, in net tons*

Year	Northern	Eastern Middle	Western Middle	Southern	Total
1940.....	13,000	139,000	250,000	362,000	764,000
1941.....	113,000	57,000	519,000	387,000	1,076,000
1942.....	291,000	420,000	1,413,000	524,000	2,648,000
1943.....	1,630,000	1,088,000	2,102,000	1,208,000	5,028,000
1944.....	1,156,000	744,000	2,528,000	1,700,000	6,128,000

¹ Includes some washery coal.² A small quantity of culm-bank coal was put through breakers in Sullivan County.

TABLE 18.—*Pennsylvania anthracite shipped in 1944, by regions and sizes*

Size	Breaker shipments						Grand total
	Lehigh region	Schuylkill region	Wyoming region	Sullivan County	Total— Excluding Sullivan County Including Sullivan County	Washery shipments	Dredge shipments
<i>Net tons</i>							
Lump and Broken.....	53,312	22,652	109,804	.....	185,768	.....	185,768
Egg.....	656,792	1,124,654	1,968,066	.....	3,769,512	.....	3,769,512
Stove.....	2,112,563	3,056,167	6,424,518	.....	11,611,416	8,946	8,946
Chestnut.....	2,486,371	3,927,553	3,309,069	18,168	13,317,002	238,077	238,077
Pea.....	1,027,106	1,674,250	1,654,975	27,777	4,356,331	4,500,240	4,500,240
Total domestic sizes.....	6,286,144	9,805,276	17,130,441	79,034	33,300,895	235,310	4,619,424
Buckwheat No. 1.....	1,577,142	2,788,614	3,179,823	15,698	7,545,579	1,042,539	.....
Buckwheat No. 2 (Rice).....	1,058,857	1,800,584	1,629,864	2,070	4,489,305	508,362	14,025
Buckwheat No. 3 (Barley).....	1,216,862	2,412,446	1,529,460	.....	5,158,768	429,321	56,638
Buckwheat No. 4.....	273,847	1,025,962	1,316,130	.....	1,643,751	676,921	217,037
Other (including silt).....	593,273	1,197,296	120,592	28,692	1,911,161	580,386	451,401
Total steam sizes.....	4,719,981	8,224,022	6,775,869	46,460	19,719,872	254,658	342,055
Grand total.....	11,006,125	18,029,298	23,906,310	125,494	52,941,733	2,449,648	1,081,156
<i>Value</i>							
Lump and Broken.....	\$594,524	\$173,808	\$819,223	.....	\$1,387,555	.....	\$1,387,555
Egg.....	4,978,668	8,510,870	14,088,300	.....	28,486,838	.....	28,486,838
Stove.....	16,084,145	23,298,832	48,446,050	.....	87,829,027	\$65,030	87,894,057
Chestnut.....	18,547,303	29,980,310	52,405,883	\$125,624	100,942,496	\$1,720,334	102,662,830
Pea.....	6,329,407	10,320,145	9,961,634	226,088	26,611,186	\$4,132,788	30,743,974
Total domestic.....	46,334,047	72,301,965	126,621,090	166,613	245,777,799	1,399,763	28,177,552
Buckwheat No. 1.....	7,103,650	12,694,395	14,381,119	618,325	245,775,427	7,317,915	253,093,342
Buckwheat No. 2 (Rice).....	3,866,535	6,313,595	5,953,398	62,916	34,202,080	2,192,796	36,454,071
Buckwheat No. 3 (Barley).....	3,100,152	5,914,701	4,046,735	4,206	16,133,528	1,452,869	17,586,397
Buckwheat No. 4.....	530,510	1,811,792	1,690,861	.....	13,061,688	1,658,901	15,720,589
Other (including silt).....	850,717	241,750	174,650	58,819	2,933,163	891,317	3,824,485
Total steam.....	15,511,594	26,876,233	25,146,763	125,941	67,534,560	354,784	1,604,730
Grand total.....	61,845,611	99,178,198	151,767,853	644,266	312,791,662	6,550,507	75,815,628
					313,435,928	13,968,522	1,604,730
							328,909,170

<i>Average value per ton</i>									
<i>Lump and Broken.</i>	\$7.40	\$7.07	\$7.46	\$7.47	\$7.47	\$7.47	\$7.47	\$7.47	\$7.47
<i>Stove.</i>	7.86	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98
<i>Sem.</i>	7.61	7.62	7.64	7.68	7.68	7.68	7.68	7.68	7.68
<i>Chestnut.</i>	7.61	7.04	7.54	7.68	7.68	7.68	7.68	7.68	7.68
<i>Pea.</i>	6.16	6.16	6.02	6.11	6.11	6.11	6.11	6.11	6.10
Total domestic.	7.37	7.37	7.39	7.38	7.38	7.38	7.38	7.38	7.37
Buckwheat No. 1.	4.54	4.52	4.52	4.52	4.52	4.52	4.52	4.52	4.51
Buckwheat No. 2 (Rice).	3.65	3.51	3.65	3.59	3.59	3.59	3.59	3.59	3.56
Buckwheat No. 3 (Barley).	2.55	2.45	2.65	2.53	2.53	2.53	2.53	2.53	2.49
Buckwheat No. 4.	1.94	1.77	1.87	1.82	1.82	1.82	1.82	1.82	1.67
Other (including silt).	1.43	1.23	1.45	1.36	1.36	1.36	1.36	1.36	1.40
Total steam.	3.29	3.27	3.71	3.42	3.42	3.42	3.42	3.42	3.25
Grand total.	5.62	5.50	6.35	5.91	5.91	5.91	5.91	5.91	5.71

† Figures of shipments from breakers include some culm-bank coal handled in the breakers.

‡ Quantity of Lump included is insignificant.

§ A small amount of Stove included in Chestnut.

TABLE 19.—*Pennsylvania anthracite produced in 1944, by counties*

County	Total shipments		Sold to local trade		Used for power		Total production	
	Net tons	Value ¹	Net tons	Value	Net tons	Value	Net tons	Value ¹
Carbon.....	4,203,584	\$23,303,262	94,243	\$610,414	117,444	\$354,002	4,415,271	\$24,267,678
Columbia.....	1,058,044	6,239,951	46,843	187,036	47,372	83,551	1,152,259	6,510,538
Dauphin.....	329,722	1,053,576	218,997	401,544	3,180	6,355	551,899	1,461,515
Lackawanna.....	7,314,858	44,218,368	980,499	6,053,531	393,422	889,983	8,698,779	51,161,882
Luzerne.....	21,337,486	134,355,664	1,548,350	9,035,314	1,391,209	2,270,329	24,277,045	145,661,307
Northumberland.....	5,678,720	29,033,049	283,624	1,513,019	51,000	90,743	6,013,344	30,636,811
Schuylkill.....	17,204,640	89,064,682	535,552	3,296,000	289,472	690,098	18,029,664	93,050,780
Sullivan.....	125,494	644,266	21,723	128,604			147,217	772,870
Susquehanna and Wayne.....	184,299	680,026	2,706	17,183	2,028	5,197	189,033	702,406
Berks, Lancaster, Lebanon, Northampton, and Snyder ²	203,723	316,326	33,104	40,748	25	23	236,852	357,097
Total.....	57,640,570	328,909,170	3,765,641	21,283,433	2,295,152	4,390,281	63,701,363	354,582,884

¹ Value given for shipments is value at which coal left possession of producing company and does not include margins of separately incorporated sales companies.

² Counties producing dredge coal only.

TABLE 20.—*Sizes of Pennsylvania anthracite shipped from breakers, 1942-44, by regions, in percent of total*

[Note that shipments of dredge and washery coals are not included]

Size	Percent of total shipments								
	Lehigh region			Schuylkill region			Wyoming region		
	1942	1943	1944	1942	1943	1944	1942	1943	1944
Lump ¹ and Broken.....	0.6	0.7	0.5	0.2	0.5	0.1	0.2	0.2	0.5
Egg.....	4.3	6.1	6.0	4.2	5.7	6.2	6.1	8.5	8.3
Stove.....	21.7	19.6	19.2	18.1	17.1	17.0	27.9	27.6	26.9
Chestnut.....	23.6	22.0	22.1	21.4	21.0	21.8	27.8	28.1	29.1
Pea.....	10.6	9.5	9.3	10.4	9.7	9.3	8.7	7.6	6.9
Total domestic.....	60.8	57.9	57.1	54.3	54.0	54.4	70.7	72.0	71.7
Buckwheat No. 1.....	14.6	14.7	14.3	16.3	15.8	15.4	13.2	12.8	13.3
Buckwheat No. 2 (Rice).....	8.6	9.3	9.6	10.2	10.1	10.0	6.4	6.6	6.8
Buckwheat No. 3 (Barley).....	9.9	11.4	11.1	12.8	13.5	13.4	7.4	6.6	6.4
Other, including Buckwheat No. 4 and silt.....	6.1	6.7	7.9	6.4	6.6	6.8	2.3	2.0	1.8
Total steam.....	39.2	42.1	42.9	45.7	46.0	45.6	29.3	28.0	28.3

Size	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
Lump ¹ and Broken.....	2.3	-----	-----	0.3	0.4	0.4	0.3	0.4	0.3
Egg.....	9.7	12.4	14.5	5.2	7.1	7.1	5.2	7.1	7.1
Stove.....	28.1	20.6	26.4	23.6	22.4	21.9	23.6	22.4	21.9
Chestnut.....	29.0	22.3	22.1	24.9	24.5	25.2	24.9	24.5	25.2
Pea.....	-----	-----	-----	9.6	8.7	8.2	9.6	8.7	8.3
Total domestic.....	69.1	55.3	63.0	63.6	63.1	62.8	63.6	63.1	62.8
Buckwheat No. 1.....	21.2	10.8	12.5	14.5	14.2	14.3	14.5	14.2	14.2
Buckwheat No. 2 (Rice).....	-----	-----	1.6	8.0	8.3	8.5	8.0	8.3	8.5
Buckwheat No. 3 (Barley).....	-----	-----	-----	9.6	9.9	9.7	9.6	9.9	9.7
Other, including Buckwheat No. 4 and silt.....	9.7	33.9	22.9	4.3	4.5	4.7	4.3	4.5	4.8
Total steam.....	30.9	44.7	37.0	36.4	36.9	37.2	36.4	36.9	37.2

¹ Quantity of Lump included is insignificant.

AVERAGE VALUE AND SALES REALIZATION

The average realization figures in this study represent value at the breaker, washery, or dredge reported by the operating companies. The company is requested to "estimate value of the product not sold" and to "exclude selling expenses" in making its report. From this it will be seen that when a producing concern sells its output to a separately organized sales company the value reported will exclude the margin of the sales company and may therefore be somewhat less than the circular price at which the coal is placed on the general market. This fact should be borne in mind in considering the variations in value among different regions, for the same sizes of coal, as shown in the tables.

The average sales realization per net ton on breaker shipments was \$5.91 in 1944, compared with \$5.38 in 1943—a 9.9-percent increase. (See table 21.)

With the inclusion of local sales, colliery fuel, washery coal, and dredge coal the average value per net ton of the total 1944 production is \$5.57, compared with \$5.06 in 1943. (See table 22.)

TABLE 21.—Average sales realization per net ton on Pennsylvania anthracite shipments from breakers, 1942-44, by regions and sizes

[Value does not include margins of separately incorporated sales companies]

Size	Lehigh region			Schuylkill region			Wyoming region		
	1942	1943	1944	1942	1943	1944	1942	1943	1944
Lump and Broken.....	\$5.92	\$6.78	\$7.40	\$6.22	\$6.83	\$7.67	\$6.01	\$6.69	\$7.46
Egg.....	6.33	7.01	7.58	6.21	6.97	7.58	6.23	6.93	7.54
Stove.....	6.33	6.99	7.61	6.24	6.99	7.62	6.26	6.95	7.54
Chestnut.....	6.36	7.00	7.61	6.26	6.99	7.64	6.27	6.95	7.54
Pea.....	4.91	5.48	6.16	4.80	5.48	6.16	4.86	5.48	6.02
Total domestic.....	6.09	6.75	7.37	5.97	6.71	7.37	6.09	6.79	7.39
Buckwheat No. 1.....	3.50	4.00	4.54	3.40	3.96	4.52	3.49	4.04	4.52
Buckwheat No. 2 (Rice).....	2.69	3.13	3.65	2.53	3.05	3.61	2.71	3.21	3.65
Buckwheat No. 3 (Barley).....	1.97	2.26	2.55	1.80	2.19	2.45	1.96	2.35	2.65
Total steam.....	2.57	2.93	3.29	2.43	2.87	3.27	2.75	3.25	3.71
Total all sizes.....	4.71	5.14	5.62	4.35	4.95	5.50	5.11	5.80	6.35

Size	Sullivan County			Total—					
				Excluding Sulli- van County			Including Sulli- van County		
Lump and Broken.....	\$3.38	-----	-----	\$6.04	\$6.77	\$7.47	\$6.03	\$6.77	\$7.47
Egg.....	-----	-----	-----	6.24	6.96	7.56	6.24	6.96	7.56
Stove.....	4.05	\$5.63	\$6.91	6.26	6.97	7.58	6.26	6.96	7.57
Chestnut.....	4.04	5.51	6.83	6.28	6.97	7.58	6.28	6.97	7.58
Pea.....	3.10	4.85	6.00	4.85	6.48	6.11	4.85	5.48	6.11
Total domestic.....	3.62	5.27	6.56	6.05	6.76	7.38	6.05	6.76	7.38
Buckwheat No. 1.....	2.40	3.90	4.01	3.46	4.00	4.52	3.46	4.00	4.52
Buckwheat No. 2 (Rice).....	-----	-----	2.03	2.63	3.12	3.60	2.63	3.12	3.59
Buckwheat No. 3 (Barley).....	-----	-----	-----	1.89	2.25	2.53	1.89	2.25	2.53
Total steam.....	1.77	2.37	2.71	2.58	3.02	3.42	2.58	3.02	3.42
Total all sizes.....	3.05	3.98	5.13	4.79	5.38	5.91	4.79	5.38	5.91

¹Quantity of Lump included is insignificant.

TABLE 22.—Average value per ton of Pennsylvania anthracite shipments, local sales, colliery fuel, and total production, 1943-44, by regions ¹

[Note that values in this table include washery and dredge coal]

Region	1943				1944			
	Shipments	Local sales	Colliery fuel	Total production	Shipments	Local sales	Colliery fuel	Total production
Lehigh.....	\$5.09	\$5.92	\$2.49	\$5.04	\$5.56	\$6.54	\$2.85	\$5.51
Schuylkill.....	4.63	3.68	1.87	4.52	5.14	4.78	1.99	5.08
Wyoming.....	5.75	5.50	1.57	5.48	6.28	5.90	1.69	5.99
Total, excluding Sullivan County.....	5.22	4.94	1.75	5.06	5.71	5.65	1.91	5.57
Sullivan County.....	3.98	.....	.....	3.98	5.13	5.92	.....	5.25
Grand total.....	5.21	4.94	1.75	5.06	5.71	5.65	1.91	5.57

¹ Value given for shipments is value at which coal left possession of producing company and does not include margins of separately incorporated sales companies.

LABOR STATISTICS

The number of men employed in the Pennsylvania anthracite industry continued to decline in 1944, totaling 77,591 men, compared with 79,153 in 1943. This figure was several thousand below the number necessary to produce enough anthracite to meet requirements. The decline may be attributed largely to induction of men into the armed forces and to others obtaining employment in nearby war industries.

The employment statistics in this chapter do not include workers in "bootleg" coal mining conducted in the Southern and Western Middle fields of the Pennsylvania anthracite regions. According to the Anthracite Committee, 10,762 men were working in this industry in March 1941, and in March 1945 a comparable survey revealed 1,806 men employed. Although these workers are not included in the employment data, the coal produced by some of them was purchased by the legitimate industry for preparation and shipment to market, and coal so purchased is included in the production tables of this chapter. Complete employment data for the "bootleg" holes from which this coal was produced are not available. In calculating the output per man per day, therefore, the tons of "bootleg" coal purchased by the industry proper were deducted from the total tonnage reported by the operators, and the resulting production was then used to calculate the output per man per day. It is true that part of the time of the men employed at the preparation plants of the large companies was used to prepare this purchased coal for market; however, on a per-ton basis this time is insignificant, and its omission will not detract materially from the validity of the result obtained.

See tables 23 and 24 for details on labor statistics.

TABLE 23.—Men employed and days worked at operations producing Pennsylvania anthracite in 1944, by regions¹

[Includes operations of strip contractors]

Region	Average number of men employed						Average number of days plant operated	Man-days of labor	Average tons per man per day
	Underground			Surface					
	Miners and their laborers	Other	Total underground	In strip pits	In preparation plant	Other				Total surface	Grand total
Lehigh:									
Breaker.....	5,427	3,427	8,854	1,075	1,219	2,757	5,051	13,905	292
Washery.....	.....	.....	.....	9	68	164	231	231	268
Dredge.....	.....	.....	.....	.....	4	9	13	13	193
Total Lehigh.....	5,427	3,427	8,854	1,084	1,291	2,920	5,295	14,149	291
Schuylkill:									
Breaker.....	7,747	4,988	12,735	3,671	1,853	3,787	9,311	22,046	271
Washery.....	.....	.....	.....	17	218	886	1,151	1,151	270
Dredge.....	.....	.....	.....	.....	139	261	400	400	240
Total Schuylkill.....	7,747	4,988	12,735	3,688	2,240	4,934	10,862	23,597	270
Wyoming:									
Breaker.....	19,145	10,838	29,983	804	2,146	6,565	9,515	39,498	305
Washery.....	.....	.....	.....	44	103	147	147	147	231
Dredge.....	.....	.....	.....	.....	8	6	14	14	75
Total Wyoming.....	19,145	10,838	29,983	804	2,198	6,674	9,676	39,659	305
Total, excluding Sullivan County:									
Breaker.....	32,319	19,253	51,572	5,550	5,218	13,109	23,877	76,449	283
Washery.....	.....	.....	.....	26	360	1,143	1,529	1,529	266
Dredge.....	.....	.....	.....	.....	151	276	427	427	233
Total.....	32,319	19,253	51,572	5,576	5,729	14,528	25,833	77,405	292
Sullivan County: Breaker.....	67	17	84	19	40	43	102	186	271
Grand total.....	32,386	19,270	51,656	5,595	5,769	14,571	25,935	77,591	292

¹ Men employed in "bootleg" operations excluded.² Output per man per day calculated on legitimate tonnages only; "bootleg" purchases excluded.³ Represents washeries for which both production and employment were separately reported.

TABLE 24.—Men employed at operations producing Pennsylvania anthracite, 1943-44, by counties

[Includes operations of strip contractors]

County	Men		County	Men	
	1943	1944		1943	1944
Carbon.....	4,997	5,036	Sullivan.....	151	186
Columbia.....	963	1,825	Susquehanna and Wayne.....	82	41
Dauphin.....	169	285	Berks, Lancaster, Lebanon, Northampton, and Snyder ¹	93	107
Lackawanna.....	12,855	11,783	Total.....	79,153	77,591
Luzerne.....	35,467	33,977			
Northumberland.....	6,546	6,383			
Schuylkill.....	17,830	17,968			

¹ Counties producing dredge coal only.

EQUIPMENT AND METHODS OF MINING

Mechanical loading.—The tonnage of anthracite loaded mechanically in 1944 increased slightly over 1943, accounting for 36 percent of the total underground production. This tonnage no doubt will be higher in 1945 when wartime restrictions on the purchasing of equipment have been eased. Five times as much coal was loaded mechanically in the Wyoming region, where the coal measures are more adaptable to current mechanical loading methods, than in the other two regions combined. Details on mechanical loading are given in tables 25 to 27. Figure 2 illustrates the relative growth of underground mechanical and hand loading and stripping, 1928-44.

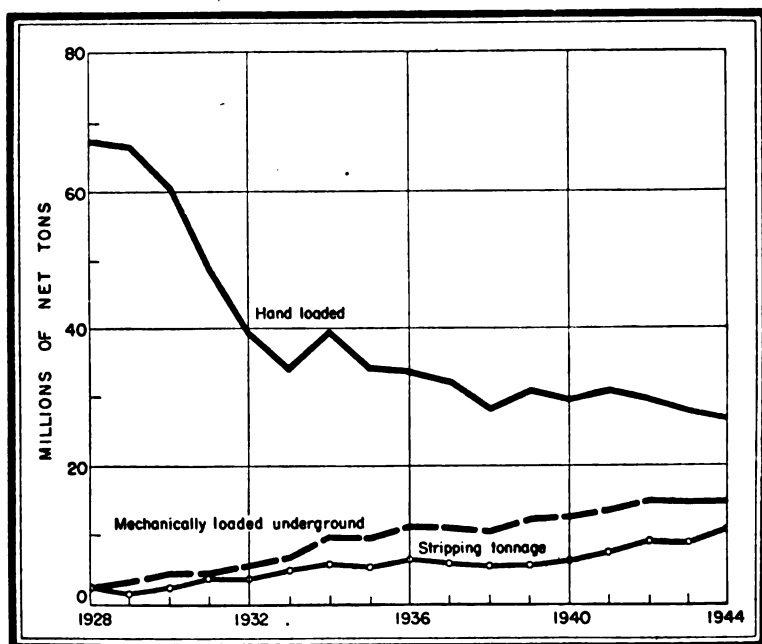


FIGURE 2.—Relative growth of mechanical loading, hand loading, and stripping of Pennsylvania anthracite, 1928-44.

TABLE 25.—*Relative growth of mechanical loading, hand loading, and stripping in Pennsylvania anthracite mines, 1940-44*

[Mechanical loading includes coal handled on pit-car loaders and hand-loaded face conveyors]

Year	Net tons			Index numbers: 1927=100		
	Mechanical loading underground	Stripping	Hand loading	Mechanical loading underground	Stripping	Hand loading
1940.....	12,326,000	6,353,000	29,191,000	554	295	41
1941.....	13,442,000	7,317,000	30,435,000	605	340	43
1942.....	14,741,000	9,071,000	30,495,000	663	421	43
1943.....	14,746,000	8,989,000	27,990,000	663	417	39
1944.....	14,975,000	10,953,000	26,800,000	674	509	38

TABLE 26.—*Pennsylvania anthracite handled by mobile loaders and scrapers and by all types of conveyors in 1944, by fields, in net tons*

Field	Scraper loaders	Pit-car loaders	Hand-loaded face conveyors, all types ¹	Total mechanically loaded underground
Northern.....	2,283,674	293,417	9,799,621	12,376,712
Eastern Middle.....	185,499	30,923	729,545	945,967
Western Middle.....	317,250	38,913	1,095,714	1,451,877
Southern.....	95,238	.....	105,352	200,590
	2,881,661	363,253	11,730,232	14,975,146

¹ Shaker chutes, etc., including those equipped with duckbills.TABLE 27.—*Pennsylvania anthracite loaded mechanically underground, 1940-44*

Year	Scrapers		Conveyors and pit-car loaders ¹		Total loaded mechanically	
	Number of units	Net tons loaded	Number of units	Net tons handled	Number of units	Net tons handled
1940.....	547	2,983,792	2,189	9,342,208	2,736	12,326,000
1941.....	605	2,673,983	2,432	10,768,004	2,937	13,441,987
1942.....	624	2,871,926	2,491	11,869,533	3,015	14,741,459
1943.....	615	2,807,289	2,701	11,938,504	3,216	14,745,793
1944.....	603	2,881,661	2,807	12,093,485	3,310	14,975,146

¹ Includes duckbills and other self-loading conveyors.² Includes mobile loaders.

Strip-pit operations.—The record production from strip pits in 1944 comprised 21 percent of the total fresh-mined output, compared with 17 percent in 1943 and 4 percent in 1930. As the output per man per day from strip pits is much higher than that in underground mines, production from this source alleviated considerably the shortage of anthracite occasioned by the scarcity of manpower. The Lehigh and Schuylkill regions are the scenes of the largest strip-pit operations in the anthracite fields, having supplied 85 percent of the total 1944 strip-pit output; the Wyoming region supplied the remaining 15 percent. The high proportionate tonnage obtained by stripping in the Lehigh and Schuylkill regions is due largely to the relative ease of mining thick-bed outcrops. In the Wyoming region the beds are thinner, thus limiting the quantity of coal recoverable by strip mining. Draglines are used extensively in removing overburden and at

some pits in loading coal. The largest dragline in the producing area, a walking-type machine with a bucket capacity of 25 cubic yards and a 180-foot boom, was placed in operation during the latter part of 1944. Details of strip-pit operations are given in table 28. Figure 3 illustrates graphically the production of anthracite from strip pits, by regions, 1928-44.

TABLE 28.—*Relative growth of Pennsylvania anthracite mined from strip pits, 1915, 1920, 1925, 1930, and 1941-44*

	Net tons mined by stripping	Percent of fresh-mined total that was stripped	Number of men employed	Average number of days worked
1915.....	1, 121, 603	(1)	(1)	(1)
1920.....	2, 054, 441	2.5	(1)	(1)
1925.....	1, 578, 478	2.7	(1)	(1)
1930.....	2, 536, 288	3.7	(1)	(1)
1941.....	7, 316, 574	14.3	4, 609	191
1942.....	9, 070, 933	16.7	4, 526	211
1943.....	8, 989, 387	17.4	5, 084	229
1944:				
Lehigh region.....	2, 327, 308	23.2	1, 084	259
Schuylkill region.....	6, 960, 332	43.7	3, 688	243
Wyoming region.....	1, 651, 910	6.2	804	246
Total, excluding Sullivan County.....	10, 939, 550	20.8	5, 576	246
Sullivan County.....	13, 480	10.1	19	212
Grand total, 1944.....	10, 953, 030	20.8	5, 595	246

¹ Data not available.

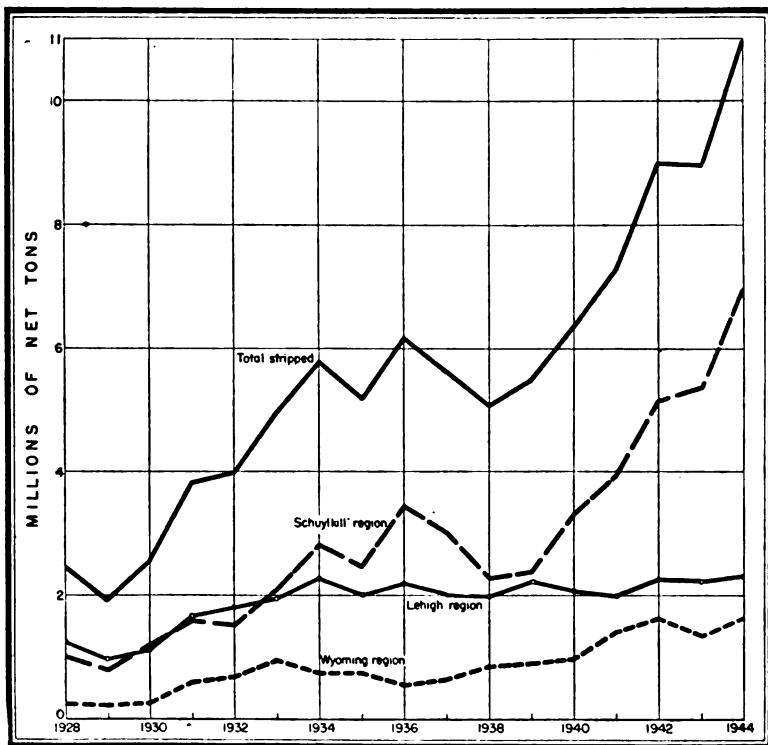


FIGURE 3.—Pennsylvania anthracite mined from strip pits, by regions, 1928-44.

Cutting machines.—The quantity of anthracite cut by machines in 1944 decreased 18 percent compared with 1943; details are shown in table 29.

Dredge coal.—The streams draining the anthracite regions have been a source of coal since about 1890. During the war period this coal has played an important part in alleviating shortages of industrial coal in the market adjacent to the anthracite regions. The dredging industry reached a peak in 1941, when 1,518,000 net tons of anthracite were taken from the river and creek beds; in 1944 dredge output totaled 1,373,000 tons, virtually all of which was Buckwheat No. 3 and smaller sizes. (See table 30.)

TABLE 29.—*Pennsylvania anthracite cut by machines, 1943-44, by regions*

Region	1943			1944		
	Cutting machines		Net tons cut by machines	Cutting machines		Net tons cut by machines
	Permissible	All other types		Permissible	All other types	
Lehigh.....	6	-----	29, 400	-----	-----	-----
Schuylkill.....	-----	-----	-----	-----	-----	-----
Wyoming.....	129	76	1, 595, 483	141	53	1, 336, 082
Total, excluding Sullivan County..	135	76	1, 624, 883	141	53	1, 336, 082
Sullivan County.....	-----	-----	-----	-----	-----	-----
Grand total.....	135	76	1, 624, 883	141	53	1, 336, 082

TABLE 30.—*Pennsylvania anthracite produced by dredges in 1944, by rivers*

River (including tributaries)	Net tons	Value	
		Total	Average
Lehigh.....	40, 894	\$70, 005	\$1. 71
Schuylkill.....	494, 371	695, 876	1. 41
Susquehanna.....	837, 472	1, 318, 550	1. 57
	1, 372, 737	2, 084, 431	1. 52

FOREIGN TRADE ¹

Anthracite exported from the United States in 1944 totaled 4,185,933 net tons compared with 4,138,680 tons in 1943. Virtually all of the exported coal was shipped to Canada, where shortages of heating gas and coke created a strong demand for anthracite. Details of imports and exports are shown in tables 31 and 32.

Canadian market.—Coal and lignite production in Canada in 1944 decreased 4.8 percent from 1943, whereas coke production increased 12.8 percent. Imports of anthracite decreased 1.0 percent from 1943, but imports of bituminous and subbituminous coal increased 0.5 percent. Coal available for consumption in 1944 was 1.5 percent less than in 1943, whereas coke available for consumption increased 7.4 percent.

See table 33 for coal and coke statistics in Canada.

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 31.—*Anthracite imported for consumption in the United States, 1943-44, by countries and customs districts, in net tons*

	1943	1944		1943	1944
<i>Country</i>			<i>Customs district—Con.</i>		
Canada.....	224	9	New York.....	1,829	9
United Kingdom ¹	165,796	11,838	Vermont.....		
	166,020	11,847		166,020	11,847
<i>Customs district</i>					
Maine and New Hampshire..	133,874	11,838			
Massachusetts.....	30,317				

¹ United Kingdom of Great Britain and Northern Ireland.TABLE 32.—*Anthracite exported from the United States, 1943-44, by countries, by customs districts and ports, of export, in net tons*

	1943	1944		1943	1944
<i>Country</i>			<i>Customs district</i>		
North America:			North Atlantic:		
Bermuda.....	262	1,267	Maine and New		
Canada.....	4,096,896	4,144,297	Hampshire.....	15,933	26,629
Central America:			Massachusetts.....	8	3
British Honduras.....	(¹) 6	3	New York.....	21,355	17,181
Guatemala.....		6	Philadelphia.....	39,702	34,317
Nicaragua.....	1		South Atlantic:		
Mexico.....	363	155	Maryland.....	264	2,818
Newfoundland and			Virginia.....		3,512
Labrador.....	1,567	1,325	Gulf coast:		
West Indies:			Florida.....	375	45
British.....	88	151	Mobile.....	21	75
Cuba.....	22,866	32,089	New Orleans.....	123	1,152
Curaçao (N. W.			Mexican border:		
I.).....	110	100	Arizona.....	232	43
Dominican Re-			El Paso.....	1	1
public.....	10		Laredo.....	76	100
Other North America.		8	Pacific coast:		
South America:			Oregon.....	60	
Bolivia.....	56		San Diego.....	50	11
Brazil.....	15,957	4,957	Northern border:		
Other South America.	294	1,325	Buffalo.....	2,130,922	2,141,160
Europe:			Dakota.....	1,021	1,671
Portugal.....	10	187	Duluth and Superior..	7,740	4,690
U. S. S. R.....	60		Michigan.....	13,974	981
United Kingdom ²	132	59	Ohio.....	14,689	18,261
Africa.....	2	4	Rochester.....	171,234	287,320
	4,138,680	4,185,933	St. Lawrence.....	1,642,168	1,634,425
			Vermont.....	78,732	11,538
				4,138,680	4,185,933

¹ Less than 1 ton.² United Kingdom of Great Britain and Northern Ireland.

TABLE 33.—*Coal and coke industry and foreign trade of Canada, 1943-44*¹

[Thousands of net tons]

	Coal								Coke from coal	
	Anthracite		Bituminous and subbituminous		Lignite		Total			
	1943	1944	1943	1944	1943	1944	1943	1944	1943	1944
Production.....			12,777	12,496	5,082	4,514	17,859	17,010	3,549	4,002
Imports.....	4,459	4,413	24,394	24,514	(²)	-----	28,853	28,927	941	813
Exports.....			1,101	999	9	11	1,110	1,010	48	43
Available for consumption.....	4,459	4,413	36,070	36,011	5,073	4,503	45,602	44,927	4,442	4,772

¹ Monthly Coal and Coke Statistics for Canada, December 1944. Data for 1944 are preliminary.² Less than 1,000 tons.

WORLD PRODUCTION

Data on world production of anthracite are incomplete because of unsettled conditions throughout the world. Available data for 1938-44 are shown in table 34.

TABLE 34.—*World production of anthracite, 1938-44, in metric tons*

[Compiled by B. B. Waldbauer]

Country	1938	1939	1940	1941	1942	1943	1944
Belgium.....	6,874,520	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Bulgaria.....	4,000	6,038	8,000	(¹)	(¹)	(¹)	(¹)
China.....	(²)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Chosen.....	1,664,000	2,064,000	(²)	(¹)	(¹)	(¹)	(¹)
Eire.....	92,157	90,455	74,170	104,871	116,290	123,387	(¹)
France.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Germany.....	(²)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Indochina.....	2,289,832	2,534,000	2,400,000	(¹)	(¹)	1,203,200	(¹)
Italy.....	132,197	107,255	(¹)	(¹)	(¹)	(¹)	(¹)
Japan ¹	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Morocco, French.....	123,200	115,600	143,500	139,874	118,102	102,293	134,300
Peru.....	1,500	3,514	4,500	4,600	5,000	22,716	(¹)
Portugal.....	281,740	294,081	286,854	436,324	404,144	368,321	4393,000
Rumania.....	3,266	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Spain.....	440,253	563,963	1,095,875	1,148,332	1,242,932	1,151,762	41,525,000
Switzerland.....	3,000	2,500	47,000	42,385	108,096	104,150	51,232
U. S. S. R.: Asiatic.....	(²)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
European.....	(²)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
United Kingdom.....	6,378,904	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
United States.....	41,820,115	46,708,319	46,705,836	51,136,164	54,728,109	55,014,679	57,788,602
World total.....	108,768,115	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Total, exclusive of United States.....	66,948,000	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)

¹ Data not available.² Estimate included in total.³ Anthracite output of Japan said to average about 225,000 tons a year. Production figures not available.⁴ Estimate.

COKE AND BYPRODUCTS

By J. A. DE CARLO, M. M. OTERO, AND J. A. CORGAN

SUMMARY OUTLINE

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SUMMARY

In 1944 the coke industry, with increased byproduct-coking capacity, surpassed all earlier production records, supplying coke and byproducts vitally needed for war and many other essential industries. This outstanding production record not only enabled the blast furnaces to maintain an operating ratio of 91.7 percent of capacity but also increased by a million and a half tons the quantity of coke available for the domestic market. The efficient coordination of labor and management reflected in the continuity of operations in the byproduct segment of the industry was an important factor in accomplishing this record.

The combined production of byproduct and beehive coke totaled 74,037,817 tons in 1944, an increase of 3 percent over 1943. The ultimate increase of 3 percent represented in the record output was registered from a 5-percent increase in the production of byproduct coke and a proportionate decrease of 12 percent in the output of beehive coke, resulting generally from the expansion of byproduct coke-making facilities. A shortage of labor and coking coal at the beehive ovens contributed also to the decline of coke from this source.

An important factor in achieving the record production of byproduct coke in 1944 was the byproduct-coal diversion and stock-pile program initiated in 1943 and continued through 1944 by the Solid Fuels Administration for War. Some of the operators were unable to contract for enough coal to keep their plants running at capacity, and to alleviate this situation the above agency issued specific directives

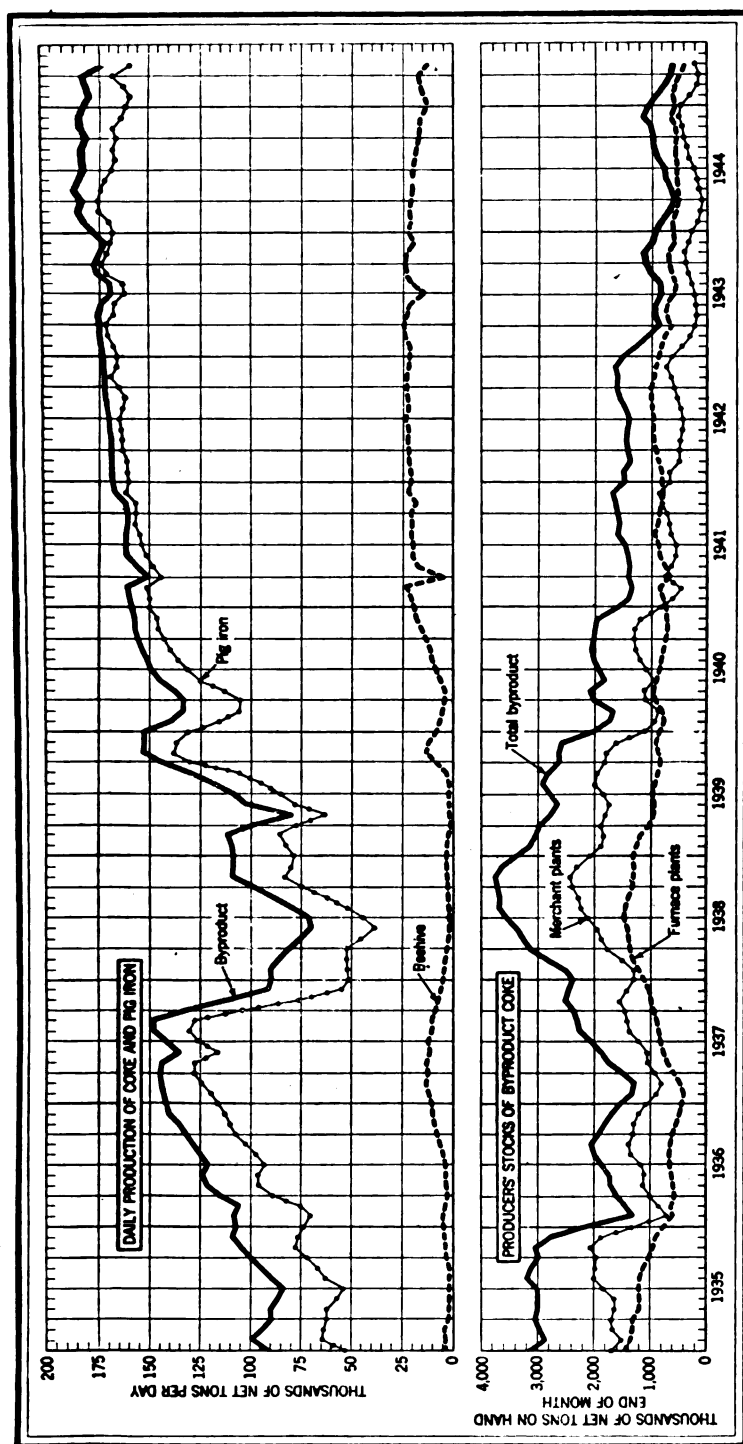


FIGURE 1.—Average daily production of beehive and byproduct coke and pig iron and producers' stocks of byproduct coke, 1935-44, by months.

during the summer and fall requiring coal producers to ship additional tonnages to these plants. Coal was also diverted from by-product-coke plants with large stock piles as well as industrial plants using byproduct coal for generating steam. The Bureau of Mines continued to work closely with the Solid Fuels Administration for War in collecting and compiling current statistical data relating to requirements, consumption, stocks, and days' supply of coking coal at byproduct-coke plants.

Requirements of coke paralleled the output, and calculated consumption for all uses in the United States totaled 72,971,401 tons, an increase of 2 percent over 1943. As in previous years, about 80 percent of the coke consumed was used as metallurgical fuel in blast furnaces. Coke used for other purposes (in foundries, for manufacturing water gas, and other industrial uses) declined slightly, whereas the consumption of domestic coke increased 37 percent over 1943.

The average cost of coal per net ton delivered at byproduct and beehive ovens increased 8 percent over 1943 and reached an all-time high of \$4.90. The average cost per ton of \$5.08 for byproduct coal was 38 percent higher than the immediate prewar maximum of 1940 and approached the peak cost of \$5.40 per ton in 1920. In the beehive industry, coal costs exceeding all previous figures were \$0.16 per ton higher than the previous all-time high of \$3.14 in 1920. These increases in 1944 were due largely to the general increase in mining costs occasioned by higher labor costs under the wage agreement of November 3, 1943, between the coal producers and the miners. As coke prices are determined largely by coal and labor costs, the average realization per ton on coke sales advanced \$0.71 over 1943.

As in previous years, foreign trade in coke was insignificant; in fact, exports amounted to but 1 percent of the total coke output, and imports, all from Canada, constituted only 0.09 percent of the calculated consumption of the country.

Accompanying the increased activity of the byproduct-coke industry in 1944, production of the four principal byproducts soared to new levels. The output of crude tar increased 4 percent, ammonium sulfate or equivalent 5 percent, crude light oil 7 percent, and gas 5 percent. The value realized through the sales of all byproducts (excluding the value of tar used by producers and breeze produced) increased 2 percent over 1943. The importance of the coke byproducts to the war industries is illustrated by the number of allocation orders issued by the War Production Board in prior years and continued through 1944. The value of all coke, breeze, and byproducts in 1944 exceeded 700 million dollars and for the fourth consecutive year established a new peak.

The survey of employment and accidents in coke-oven plants in 1944 by the Bureau of Mines revealed that, in the byproduct-coke industry, 21,586 men were employed and worked a total of 62,848,032 man-hours, compared with 21,632 men working 62,652,039 man-hours during 1943 in the beehive industry, according to preliminary estimates, 3,100 men were employed for a total of 6,400,000 man-hours, compared with 4,133 men working 8,026,872 man-hours in 1943.

GOVERNMENT CONTROL MEASURES

With the coke industry heavily engaged in war production during 1944, various regulations established by Government war agencies in

previous years for the conservation, efficient utilization, and price stabilization of the products related directly to the coke industry were continued in general. However, in order to coordinate the control of coking coal, coke, and byproducts in all their forms and applications it became necessary to revise and modify the terms of some of the measures previously established and in some cases to promulgate new regulations. The outstanding actions taken by the war agencies in 1944 with respect to the coke industry are summarized below.

War Production Board.—On April 28, 1944, the War Production Board delegated to the Solid Fuels Administration for War power to control the distribution of coke from all sources whenever intended for ultimate domestic use. Authority had been previously delegated to control the distribution of coke for domestic use from retail dealers' yards only. Because of the close relationship between the production of coke and steel, movement of coke for industrial use remained under the jurisdiction of the War Production Board.

Effective July 1, 1944, toluol, benzol, and xylol became subject to the provisions of General Allocation Order M-300, which governed the use and delivery of these chemicals; byproduct ammonia and sulfate of ammonia were made subject to this order December 26, 1944. Previous allocation orders regulating these products were revoked.

Office of Price Administration.—Maximum price regulations¹ for byproduct and beehive coke in effect at the end of 1943 were continued in 1944. Amendment 2 to Maximum Price Regulation 29, issued on January 21, increased the price of byproduct coke produced in the East \$0.50 per ton to compensate for added costs of coal resulting from the wage agreement of November 3, 1943. Amendment 2 to M. P. R. 77 increased the price of beehive coke, except for furnace coke made in Connellsville district of Pennsylvania, \$1 per net ton for machine-drawn coke and \$1.25 for hand-drawn coke. This amendment was issued January 4, 1944, and prices were made retroactive to November 23, 1943. Prices of beehive coke produced in Wise County, Va., were increased \$0.75 per ton by amendment 3 of January 18, retroactive to November 29, 1943. Prices of \$9.10 and \$6.50 per net ton, f. o. b. ovens, respectively, were established on February 11 (amendment 4) for beehive foundry and domestic coke produced in Fayette County, W. Va., an increase of approximately \$1 per ton over the maximum prices previously applicable to sales of such coke.

On January 11, 1944, M. P. R. 447, covering crude coal tar, was amended to eliminate the inapplicability of price regulations to transactions under participating and barter-type contracts.

Solid Fuels Administration for War.—On March 2, 1944, the Solid Fuels Administration for War issued Regulation 16 to provide for orderly shipment of byproduct coal, and coke producers were required to furnish information on the tonnages contracted for shipment during the coal year 1944-45, by sizes and sources, as well as information concerning estimated tonnages not contracted for, but required to meet minimum needs. A preference system established early in 1943 for distribution of bituminous coal mined in certain producing districts was continued under provisions of Regulation 20, issued March 30, 1944, which required that producers and whole-

¹ Bureau of Mines, *Minerals Yearbook*, 1943, p. 985.

salers (including dock operators) arrange their distribution schedules so that first preference be given to byproduct and other special-purpose coal commitments and second preference to Lake-coal commitments.

Regulation 23, issued July 17, 1944, included the preference provisions of Regulation 20; and, in addition, this regulation required that shippers in producing Districts 7 and 8, after arranging to fill orders of industrial consumers for byproduct and special-purpose coal and for Lake coal, fill orders of retail dealers whom they supplied during the 1943-44 coal year to the extent of 90 percent of their last year's shipments. The stock piling of bituminous coal by byproduct and special-purpose consumers was regulated under terms specified in revised Regulation 10, issued April 20, 1944.

Early in 1944, the S. F. A. W. placed limitations on deliveries of coke by retail dealers similar to those already in effect on anthracite and on June 20, 1944, Order 17 was issued requiring the filing by producers and wholesalers of information showing the State destinations of coke shipments for domestic use, by months, for the calendar year 1944. S. F. A. W. Order 16, issued on the same date, required the filing of data on export shipments, by sizes and uses.

TECHNOLOGIC DEVELOPMENTS

The expanded wartime requirements for coking coal, metallurgical coke, and coke byproducts have led to a corresponding growth in the demand for technical information. Seeking additional sources of fuel for the blast furnaces of the West's war-born steel industry, a Bureau of Mines diamond-drilling program proved a reserve of 15,345,000 tons of coking coal in the Kemmerer district of Lincoln County, Wyo., of which an estimated 11,215,000 tons are considered recoverable.²

Continuing its program relating to scientific studies on the carbonizing properties of American coals, the Bureau of Mines published a paper³ which discusses the development of test methods and outlines the uses to which the methods have been put in promoting the war effort. In addition, the paper brings the index of coals tested by the BM-AGA method up to date.

Several studies on the problem of economic utilization of anthracite fines as a substitute for low-volatile bituminous coal in admixtures for use in the manufacture of byproduct coke were made.⁴ Conclusions reached by these studies indicate that, in general, anthracite fines can be used in coking-coal mixtures. However, the effect of their addition varies considerably with the nature of the bituminous coals used and the operating conditions at the plant.

One of the problems encountered in the program of the Coke Production Committee and the Bureau of Mines to improve the quality of byproduct coke has been the prevalent lack of control of bulk density of the coal in the coke ovens. It is generally agreed that the chief causes

² Toenges, A. L., Davis, J. D., Turnbull, A., and Schopf, J. M., Reserves, Bed Characteristics, and Coking Properties of the Willow Creek Coal Bed, Kemmerer District, Lincoln County, Wyo.: Bureau of Mines Tech. Paper 673, 1944, 48 pp.

³ Davis, J. D., and Reynolds, D. A., Work of the Survey of the Carbonizing Properties of American Coals: Bureau of Mines Rept. of Investigations 3760, 1944, 17 pp.

⁴ Clendenin, J. D., Barclay, K. M., and Wright, C. C., The Technical and Economic Aspects of the Use of Anthracite Fines in Byproduct Coke Production: Pennsylvania State College, School of Mineral Industries, Circ. 16, State College, Pa., 1944, 104 pp.

Seymour, Wm., and Schmidt, L. D., Utilization of Anthracite Fines in the Manufacture of Byproduct Coke: Bureau of Mines Rept. of Investigations 3808, 1945, 23 pp.

of variation are probably the fluctuations in the moisture content of the incoming coal, the variations in the screen analysis of the crushed coal, and, to a lesser extent, the variations in the specific gravity of the coal particle size and its distribution, particle shape, and condition of surface. Tests were made on samples of coke-oven charges from several operating plants that were experiencing difficulties because of lack of adequate control of bulk density. Results of these tests are summarized in a report recently prepared by Landers and his associates.⁶ Some coke producers have studied the problem of finding a low-volatile coal substitute for mixing with high-volatile coal for charging high-temperature coke ovens. An account is given of the experimental work and the results obtained by the Colorado Fuel & Iron Corp. in producing and using low-temperature "char" for this purpose. "Char" is produced by partial devolatilization at a low temperature of high-volatile coal, and it is claimed that the blending of this "char" definitely has improved the quality of the coke made from Colorado coal.⁶

A process is claimed for obtaining crystalline naphthalene directly from a side stream rich in naphthalene from a tar-distillation plant. This requires maintaining the side-stream liquid at a temperature just above the crystallization temperature of naphthalene, followed by shock cooling and immediate draining and centrifuging of the crystals.⁷

POSTWAR OUTLOOK

The postwar outlook for the coal-carbonization industry seems quite favorable; and, although the present rate of producing over 74 million tons of coke per year will not be maintained, operations should be well above those of the immediate prewar years.

Past experience proves that coke production is predicated mainly on the demand for metallurgical fuel. Representatives of Government and industry have estimated that near-future demands for pig iron will vary from 40 to 50 million tons annually. Proportionately, blast-furnace and foundry-coke requirements should range from 39 to 48 million tons per year. Of the production of byproduct and beehive coke in the period 1935-39, deliveries to iron blast furnaces and foundries accounted for 70 percent; domestic consumers used 20 percent; and the remaining 10 percent was used for miscellaneous industrial purposes. In view of the relative facilities for the production and distribution of coke and byproducts, it seems reasonable to assume that the immediate postwar period will find these products consumed in much the same ratio as in the immediate prewar years. Therefore, applying 70 percent to 39 million tons—the lower of the two figures representing blast-furnace and foundry-coke requirements—total coke production in the postwar period should approximate 56,000,000 tons. As in the past, the domestic market should absorb between 8½ and 11 million tons and industrial purposes the balance. This production will be obtained primarily from byproduct ovens, as recent developments in the beehive industry indicate that production

⁶ Landers, W. S., Schmidt, L. D., and Seymour, Wm., Control of Bulk Densities in Coke Ovens: Studies on Coal Used at Three Byproduct Coke Plants: Bureau of Mines Rept. of Investigations 3807, 1945, 22 pp.

⁷ Price, J. D., and Woody, G. V., Production and Use of Low-Temperature Char as a Substitute for Low-Volatile Coal in the Production of High-Temperature Coke: Am. Inst. Min. and Met. Eng., Tech. Pub. 1745, 1944, 21 pp.

⁸ Wilton, T. O., Improvements in or Relating to the Production of Naphthalene: British Patent 559, 902, Mar. 15, 1944.

from this source will decline rapidly as soon as the wartime peak demand for steel has subsided, and it will again resume the status of a standby industry.

Smoke pollution of the atmosphere is being given more attention, and many cities now have smoke-abatement ordinances. Smokeless fuels can be obtained by carbonizing coal, which is preeminently a method of using coal to a better advantage than burning it in the raw state. Recent developments in the production of synthetic rubber, plastics, insecticides, and other chemicals obtained from raw materials originating in coal carbonization will provide markets for increased quantities of the byproducts. These developments, plus potential projects now in the laboratory stage, should provide excellent and continuing opportunities for the carbonization industry in the near future. Of course, should the cost of coal advance beyond certain economic limits, it will have a retarding influence on the development of the byproduct industry in the postwar period.

TABLE 1.—*Salient statistics of the byproduct and beehive coke industry in the United States in 1944*

	Byproduct	Beehive	Total
Coke produced—			
At merchant plants:			
Quantity..... net tons.....	14, 144, 951	(1)	14, 144, 951
Value.....	\$119, 760, 289		\$119, 760, 289
At furnace plants:			
Quantity..... net tons.....	52, 919, 844		52, 919, 844
Value.....	\$359, 083, 883		\$359, 083, 883
Total:			
Quantity..... net tons.....	67, 064, 795	6, 973, 022	74, 037, 817
Value.....	\$478, 844, 172	\$49, 077, 334	\$527, 921, 506
Screenings or breeze produced:			
Quantity..... net tons.....	4, 965, 064	151, 150	5, 116, 214
Value.....	\$13, 281, 342	\$165, 650	\$13, 446, 992
Coal charged into ovens:			
Quantity..... net tons.....	94, 437, 887	10, 858, 435	105, 296, 322
Value.....	\$480, 197, 510	\$35, 831, 473	\$516, 028, 983
Average per ton.....	\$5. 08	\$3. 30	\$4. 90
Average yield in percent of coal charged:			
Coke.....	71. 01	64. 22	70. 31
Breeze (at plants actually recovering).....	5. 29	3. 51	5. 21
Ovens:			
In existence January 1.....	14, 253	17, 606	31, 919
In existence December 31.....	14, 580	16, 318	30, 898
Dismantled during year.....	61	1, 379	1, 440
In course of construction December 31.....	180	—	180
Annual capacity of ovens December 31..... net tons.....	72, 330, 200	10, 438, 386	82, 768, 586
Coke used by producer—			
In blast furnaces:			
Quantity..... do.....	37, 753, 934	674, 055	38, 427, 989
Value.....	\$282, 966, 060	\$4, 957, 103	\$287, 923, 163
In foundries:			
Quantity..... net tons.....	46, 871	—	46, 871
Value.....	\$341, 426	—	\$341, 426
To make producer gas:			
Quantity..... net tons.....	830, 790	—	830, 790
Value.....	\$5, 678, 925	—	\$5, 678, 925
To make water gas:			
Quantity..... net tons.....	882, 211	—	882, 211
Value.....	\$6, 420, 591	—	\$6, 420, 591
For other purposes:			
Quantity..... net tons.....	1, 174, 897	88, 800	1, 263, 697
Value.....	\$6, 383, 221	\$817, 804	\$7, 201, 025
Disposal of coke:			
Sold to financially affiliated corporations—			
For blast-furnace use:			
Quantity..... net tons.....	11, 747, 486	1, 899, 943	13, 647, 429
Value.....	\$70, 099, 354	\$12, 474, 267	\$82, 573, 621
For foundry use:			
Quantity..... net tons.....	3, 273	—	3, 273
Value.....	\$18, 925	—	\$18, 925

¹ Not separated into merchant or furnace plants.

TABLE 1.—*Salient statistics of the byproduct and beehive coke industry in the United States in 1944—Continued*

	Byproduct	Beehive	Total
Disposal of coke—Continued			
Sold to financially affiliated corporations—Continued			
For manufacture of water gas:			
Quantity.....net tons..	339,514	-----	339,514
Value.....	\$2,463,389	-----	\$2,463,389
For other purposes:			
Quantity.....net tons..	289,693	387	290,080
Value.....	\$2,124,612	\$2,531	\$2,127,143
Sold to other consumers—			
For blast-furnace use:			
Quantity.....net tons..	2,169,369	3,236,566	5,405,935
Value.....	\$16,473,055	\$22,814,928	\$39,287,983
For foundry use:			
Quantity.....net tons..	2,230,535	231,175	2,461,710
Value.....	\$24,608,301	\$1,936,046	\$26,544,347
For manufacture of water gas:			
Quantity.....net tons..	1,096,226	170,551	1,266,777
Value.....	\$8,955,910	\$1,244,596	\$10,200,506
For other industrial use:			
Quantity.....net tons..	1,712,005	392,988	2,104,993
Value.....	\$13,839,720	\$2,878,841	\$16,718,561
For domestic use:			
Quantity.....net tons..	6,443,329	274,214	6,717,543
Value.....	\$55,575,253	\$1,910,675	\$57,485,928
Disposal of screenings or breeze:			
Used by producer—			
For raising steam:			
Quantity.....net tons..	3,350,917	19,757	3,370,674
Value.....	\$8,526,914	\$23,204	\$8,550,118
To make producer or water gas:			
Quantity.....net tons..	36,758	-----	36,758
Value.....	\$129,341	-----	\$129,341
For other purposes:			
Quantity.....net tons..	695,425	5,832	701,257
Value.....	\$1,646,532	\$10,598	\$1,657,130
Sold:			
Quantity.....net tons..	1,018,147	84,872	1,103,019
Value.....	\$3,244,128	\$72,336	\$3,316,464
Average receipts per ton sold:			
Furnace coke (merchant sales).....	\$7.59	\$7.05	\$7.27
Foundry coke.....	\$11.03	\$8.37	\$10.78
For manufacture of water gas.....	\$8.17	\$7.30	\$8.05
Other industrial coke.....	\$8.08	\$7.33	\$7.94
Domestic coke.....	\$8.63	\$6.97	\$8.56
Screenings or breeze.....	\$3.19	\$0.85	\$3.01
Stocks on Jan. 1, 1945:			
Furnace.....net tons..	478,133	33,649	511,782
Foundry.....do.....	18,265	766	19,031
Domestic and other.....do.....	590,048	3,824	593,872
Screenings or breeze.....do.....	1,491,784	6,923	1,498,707
Exports.....do.....	-----	-----	866,835
Imports.....do.....	-----	-----	63,004
Calculated consumption.....do.....	-----	-----	72,971,401
Byproducts produced:			
Tar.....gallons.....	767,807,171	-----	767,807,171
Ammonium sulfate or equivalent.....pounds.....	1,889,806,197	-----	1,889,806,197
Gas.....M cubic feet.....	1,008,799,926	-----	1,008,799,926
Burned in coking process.....percent.....	36.98	-----	36.98
Surplus sold or used.....do.....	61.57	-----	61.57
Wasted.....do.....	1.45	-----	1.45
Crude light oil.....gallons.....	267,861,984	-----	267,861,984
Yield of byproducts per ton of coal:			
Tar.....do.....	8.13	-----	8.13
Ammonium sulfate of equivalent.....pounds.....	20.29	-----	20.29
Gas.....M cubic feet.....	10.68	-----	10.68
Crude light oil.....gallons.....	2.87	-----	2.87
Value of byproducts sold:			
Tar.....	\$21,897,933	-----	\$21,897,933
Used by producer.....	\$8,789,279	-----	\$8,789,279
Ammonium sulfate or equivalent.....	\$21,743,268	-----	\$21,743,268
Gas (surplus).....	\$94,122,400	-----	\$94,122,400
Crude light oil and derivatives.....	\$34,918,025	-----	\$34,918,025
Other byproducts ¹	\$13,313,616	-----	\$13,313,616
Total value of coke and breeze produced and byproducts sold²	\$686,910,035	\$49,242,984	\$736,153,010

¹ Includes naphthalene, tar derivatives, and miscellaneous byproducts.² Includes value of tar used by producer.

TABLE 2.—*Statistical trends of the byproduct and beehive coke industry in the United States, 1937 and 1941-44*

	1937	1941	1942	1943	1944
Coke produced:					
Byproduct.....net tons.....	49,210,748	58,482,422	62,294,909	63,742,676	67,064,795
Beehive.....do.....	3,164,721	6,704,156	8,274,035	7,933,387	6,973,022
Total.....do.....	52,375,469	65,186,578	70,568,944	71,676,063	74,037,817
Percent from byproduct ovens.....	94.0	89.7	88.3	88.9	90.6
Stocks of coke, end of year.....net tons.....	2,595,287	1,758,086	1,489,049	862,100	1,124,685
Exports, all coke.....do.....	526,683	708,971	839,582	994,607	866,835
Imports, all coke.....do.....	286,364	267,886	108,782	96,127	63,004
Consumption, calculated, all coke.....do.....	51,271,929	64,943,849	70,107,181	71,406,532	72,971,401
Disposal of coke, all coke sold or used:					
Furnace coke.....net tons.....	36,751,969	50,454,325	55,491,570	57,690,190	57,481,353
Foundry coke.....do.....	2,038,822	2,846,459	2,591,576	2,606,889	2,511,854
Other industrial (including producer and water gas).....net tons.....	4,597,894	5,390,123	6,598,842	6,999,884	6,978,062
Domestic coke.....do.....	8,107,518	6,682,959	6,061,694	4,885,528	6,717,543
Ovens:					
Byproduct, in existence, end of year.....	12,718	13,016	13,303	14,253	14,580
Beehive, in existence, end of year.....	12,194	18,669	16,295	17,666	16,318
Byproduct, under construction, end of year.....	250	181	1,327	528	180
Cost of coal charged, byproduct ovens, average per ton.....	\$3.74	\$3.92	\$4.38	\$4.75	\$5.08
Prices of coke:					
Average spot price of Connellsville furnace coke, f. o. b. ovens.....	\$4.29	\$5.92	\$6.01	\$6.46	\$7.00
Average realization on byproduct coke sold:					
Furnace coke (merchant sales).....	\$4.34	\$5.70	\$6.58	\$7.26	\$7.59
Foundry coke.....	\$8.47	\$9.76	\$10.15	\$10.17	\$11.03
Other industrial (including water gas).....	\$6.08	\$6.68	\$7.30	\$7.43	\$8.12
Domestic.....	\$6.53	\$6.96	\$7.88	\$8.21	\$8.63
Yield of byproducts per ton of coal charged:					
Tar.....gallons.....	8.67	8.52	8.41	8.11	8.13
Ammonium sulfate or equivalent.....pounds.....	21.84	21.34	20.85	20.32	20.29
Light oil.....gallons.....	2.86	2.90	2.88	2.83	2.87
Surplus gas sold or used.....M cubic feet.....	6.66	6.71	6.65	6.59	6.58
Average gross receipts for byproducts, per ton of coke produced:					
Tar sold and used ¹	\$0.502	\$0.418	\$0.473	\$0.463	\$0.458
Ammonia and its compounds.....	\$0.326	\$0.371	\$0.348	\$0.355	\$0.324
Light oil and its derivatives (including naphthalene).....	\$0.435	\$0.431	\$0.501	\$0.546	\$0.552
Surplus gas sold or used.....	\$1.483	\$1.454	\$1.426	\$1.390	\$1.403
Total byproducts, including breeze ¹	\$2.974	\$2.982	\$3.100	\$3.123	\$3.102

¹ Figures revised to exclude value of crude tar used by producers for refining. Before 1944, value of tar used by producers included the value of that refined or "topped" and accordingly pyramided slightly the credit value of crude tar and its products.

SCOPE OF REPORT

This report presents final statistics for the year 1944 on the byproduct- and beehive-coke industry of the United States, together with salient statistics concerning the related industries of low- and medium-temperature carbonization and coal-gas works. In accordance with usual procedure, most of the tables herein include comparable data for 3 or 4 preceding years. Statistics on medium- and low-temperature carbonization operations have been included with those of the byproduct industry in previous years but are shown separately in 1944, because three such companies reported and hence individual figures will not be revealed. Since only coke made by high-temperature carbonization of coal in byproduct and beehive ovens is suitable for metallurgical purposes, statistics of this report are confined thereto unless otherwise specified. Coke is also made by other processes not included in this report, among which are the refining of petroleum and of crude coal tar. The production of petroleum coke in the United States in 1944 reached 1,803,400 tons; output of coal-tar-pitch coke varied only slightly from the preceding year and totaled 82,800 tons.

Because of the extremely low ash content of petroleum and pitch coke, it is in demand as a source of comparatively pure carbon and is used widely in the manufacture of carbon electrodes.

The standard unit of measurement in the coke industry is the short, or net, ton of 2,000 pounds and, unless otherwise specified, is employed throughout this chapter.

COKE AND COKE BREEZE

MONTHLY AND WEEKLY PRODUCTION

TABLE 3.—*Byproduct, beehive, and total coke produced in the United States, 1937 and 1942-44, by months and average per day, in net tons*¹

Month	1937		1942		1943		1944	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Byproduct:								
January.....	4,360,700	140,700	5,228,900	168,700	5,400,600	174,200	5,663,400	182,700
February.....	3,992,900	142,600	4,720,300	168,600	4,907,500	175,300	5,360,800	184,900
March.....	4,495,500	145,000	5,230,700	168,700	5,431,800	175,200	5,692,800	183,700
April.....	4,350,900	145,000	5,060,400	168,700	5,280,800	178,000	5,581,700	186,000
May.....	4,479,700	144,500	5,265,800	169,900	5,406,600	174,400	5,726,000	184,800
June.....	4,024,800	134,200	5,104,800	170,200	5,066,900	168,900	5,472,800	182,400
July.....	4,423,900	142,700	5,282,800	170,400	5,273,100	170,100	5,683,800	182,700
August.....	4,573,400	147,500	5,320,000	171,600	5,473,600	178,600	5,670,300	182,900
September.....	4,427,800	147,600	5,168,400	172,300	5,347,900	178,300	5,412,300	180,400
October.....	4,035,100	130,200	5,343,800	172,400	5,445,500	175,700	5,671,900	183,000
November.....	3,222,300	107,400	5,196,000	173,200	5,152,800	171,800	5,507,300	183,600
December.....	2,823,800	91,100	5,373,400	173,300	5,555,600	179,200	5,639,700	181,900
	49,210,800	134,800	62,294,900	170,700	63,742,700	174,600	67,064,800	183,200
Beehive:								
January.....	274,300	10,600	675,400	21,800	662,700	21,400	679,900	21,900
February.....	294,600	12,300	635,500	22,700	644,100	23,000	644,200	22,200
March.....	357,300	13,200	694,400	22,400	753,200	24,300	667,600	21,500
April.....	309,700	11,900	686,600	22,900	686,500	22,900	614,500	20,500
May.....	326,500	12,600	700,200	22,600	657,500	21,200	645,300	20,800
June.....	274,800	10,600	719,000	24,000	420,400	14,000	614,900	20,500
July.....	285,100	11,000	692,800	22,300	633,900	20,400	605,100	19,500
August.....	259,000	10,000	696,700	22,500	715,600	23,100	572,500	18,500
September.....	253,900	9,800	697,600	23,300	711,600	23,700	516,200	17,200
October.....	225,500	8,700	722,100	23,300	730,400	23,600	526,700	17,000
November.....	168,800	6,500	667,400	22,200	607,000	20,200	481,200	16,000
December.....	135,200	5,200	686,300	22,100	710,500	22,900	404,900	13,100
	3,164,700	10,200	8,274,000	22,700	7,933,400	21,700	6,973,000	19,100
Total coke:								
January.....	4,635,000	151,300	5,904,300	190,500	6,063,300	195,600	6,343,300	204,600
February.....	4,287,500	154,900	5,355,800	191,300	5,551,600	198,300	6,005,000	207,100
March.....	4,852,800	158,200	5,925,100	191,100	6,185,000	199,500	6,360,400	205,200
April.....	4,660,600	156,900	5,747,000	191,600	5,967,300	198,900	6,196,200	206,500
May.....	4,806,200	157,100	5,965,800	192,500	6,064,100	195,600	6,373,300	205,600
June.....	4,299,600	144,800	5,823,600	194,200	5,487,300	182,900	6,087,700	202,900
July.....	4,709,000	153,700	5,975,600	192,700	5,907,000	190,500	6,268,900	202,200
August.....	4,832,400	157,500	6,016,700	194,100	6,189,200	199,700	6,242,800	201,400
September.....	4,681,700	157,400	5,866,000	195,600	6,059,500	202,000	5,928,500	197,600
October.....	4,260,600	138,900	6,065,900	195,700	6,175,900	199,300	6,198,600	200,000
November.....	3,391,100	113,900	5,863,400	195,400	5,759,800	192,000	5,988,500	199,600
December.....	2,959,000	96,300	6,059,700	195,400	6,266,100	202,100	6,044,600	195,000
	52,375,500	145,000	70,568,900	193,400	71,676,100	196,300	74,037,800	202,300

¹ Before 1941 daily average production of beehive coke was calculated by subtracting Sundays and holidays in each month; 1942-44 daily average has been calculated by dividing total monthly production by total number of days in month.

TABLE 4.—*Beehive coke produced in the United States in 1944, by weeks*

(Estimated from railroad shipments)

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
Jan. 1.....	120,900	May 13.....	144,100	Sept. 23.....	122,700
8.....	150,300	20.....	141,100	30.....	116,300
15.....	155,000	27.....	143,500	Oct. 7.....	118,000
22.....	166,100	June 3.....	128,800	14.....	118,000
29.....	164,800	10.....	150,700	21.....	122,200
Feb. 5.....	162,900	17.....	147,500	28.....	122,500
12.....	155,200	24.....	154,400	Nov. 4.....	111,500
19.....	148,700	July 1.....	147,100	11.....	115,900
26.....	154,100	8.....	127,000	18.....	115,500
Mar. 4.....	147,800	15.....	141,900	25.....	106,100
11.....	147,000	22.....	148,100	Dec. 2.....	109,300
18.....	147,500	29.....	139,400	9.....	106,700
25.....	143,600	Aug. 5.....	142,900	16.....	87,100
Apr. 1.....	142,700	12.....	123,400	23.....	99,700
8.....	145,900	19.....	133,600	30.....	83,000
15.....	142,300	26.....	122,800	31.....	12,600
22.....	144,800	Sept. 2.....	113,900		
29.....	138,600	9.....	110,900		
May 6.....	141,200	16.....	125,400		6,973,100

1 day only.

TABLE 5.—*Byproduct coke produced in the United States in 1944, by months and States, in net tons*

(Based upon reports from all producers)

State	January	February	March	April	May	June	July
Alabama.....	487,100	466,300	477,800	474,800	488,800	469,300	479,400
California.....	27,800	27,600	29,500	28,500	31,400	29,200	27,800
Colorado.....	57,300	53,800	58,900	58,700	55,400	39,700	48,600
Illinois.....	311,500	294,400	313,500	317,300	324,600	311,600	324,900
Indiana.....	788,800	735,200	769,600	735,200	761,200	721,500	753,400
Maryland.....	186,200	174,200	168,800	164,300	171,100	166,800	174,200
Massachusetts.....	99,900	94,700	100,900	97,400	100,300	97,300	96,400
Michigan.....	257,500	238,300	255,200	248,600	257,000	249,500	255,500
Minnesota.....	80,700	75,400	78,400	75,200	73,500	70,100	73,100
New Jersey.....	82,000	78,000	81,500	81,800	83,800	81,900	85,000
New York.....	501,600	487,700	511,800	517,300	523,300	502,200	511,500
Ohio.....	861,700	834,400	908,600	882,600	900,400	863,500	884,100
Pennsylvania.....	1,448,200	1,348,800	1,438,400	1,388,100	1,433,300	1,373,200	1,438,600
Tennessee.....	20,200	18,800	20,100	18,500	17,500	16,800	17,000
Texas.....			6,300	25,600	30,600	28,600	16,300
Utah.....	39,200	46,300	55,500	64,100	60,200	63,400	65,200
West Virginia.....	217,200	203,200	221,600	214,800	222,100	215,100	222,800
Connecticut, Kentucky, Missouri, Rhode Is- land, and Wisconsin.....	196,500	184,800	198,400	188,900	194,100	183,200	191,000
	5,663,400	5,360,800	5,692,800	5,581,700	5,728,000	5,472,800	5,663,800
At merchant plants.....	1,206,800	1,185,000	1,205,700	1,165,300	1,196,500	1,149,400	1,179,100
At furnace plants.....	4,456,600	4,225,800	4,487,100	4,416,400	4,531,500	4,323,400	4,484,700

State	August	September	October	November	December	Total
Alabama.....	477,200	461,400	478,700	473,300	493,500	5,727,600
California.....	29,000	27,600	28,300	26,300	26,800	339,600
Colorado.....	53,800	56,000	57,400	54,700	56,200	650,500
Illinois.....	339,800	324,800	346,500	332,800	337,100	3,378,800
Indiana.....	749,000	701,000	717,300	693,300	695,500	8,821,000
Maryland.....	172,200	168,100	172,600	168,100	171,600	2,058,200
Massachusetts.....	95,400	97,700	100,200	98,300	100,400	1,177,900
Michigan.....	256,300	238,300	254,000	241,400	253,800	3,006,400
Minnesota.....	74,100	69,700	73,800	73,200	76,900	894,100
New Jersey.....	85,300	81,300	84,700	89,100	108,500	1,022,900
New York.....	518,500	501,700	526,000	496,500	504,500	6,102,600
Ohio.....	870,200	775,700	868,200	850,200	853,300	10,338,900
Pennsylvania.....	1,435,900	1,400,000	1,440,400	1,398,800	1,432,900	16,978,600
Tennessee.....	16,000	16,800	18,300	19,300	20,200	219,500
Texas.....	13,100	14,200	16,100	17,600	16,800	184,600
Utah.....	67,000	69,000	69,200	63,900	77,400	739,400
West Virginia.....	224,800	222,700	228,200	221,700	223,400	2,637,600
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin.....	192,700	186,400	194,000	188,800	190,900	2,289,700
	5,670,300	5,412,300	5,671,900	5,507,300	5,639,700	67,064,800
At merchant plants.....	1,182,800	1,151,200	1,194,000	1,168,900	1,210,300	14,145,000
At furnace plants.....	4,487,500	4,261,100	4,477,900	4,338,400	4,429,400	52,919,800

TABLE 6.—*Beehive coke produced in the United States in 1944, by months and States, in net tons*

[Based upon reports from producers]

State	January	February	March	April	May	June	July
Colorado.....	6,300	6,700	7,000	6,200	7,200	7,400	6,500
Kentucky.....	11,700	7,900	10,200	9,900	8,100	8,000	6,800
Pennsylvania.....	586,000	563,300	582,000	541,100	572,500	547,900	542,600
Tennessee.....	2,700	3,300	2,800				
Utah.....	9,800	4,500	1,200	1,200	1,200	800	500
Virginia.....	25,400	21,700	26,200	23,000	22,000	17,700	17,100
West Virginia.....	38,000	36,800	38,200	33,100	34,300	33,100	31,600
	679,900	644,200	667,600	614,500	645,300	614,900	605,100

State	August	September	October	November	December	Total
Colorado.....	7,000	7,200	7,000	6,200	7,000	81,700
Kentucky.....	5,500					68,100
Pennsylvania.....	511,600	465,600	472,200	428,100	358,000	6,170,900
Tennessee.....						8,800
Utah.....	500	200	500	600	400	21,400
Virginia.....	18,400	17,500	18,700	18,000	17,400	243,100
West Virginia.....	29,500	25,700	28,300	28,300	22,100	379,000
	572,500	516,200	526,700	481,200	404,900	6,973,000

PRODUCTION BY FURNACE AND NONFURNACE PLANTS

Definitions used by the Bureau of Mines classifying byproduct-coke plants according to "furnace" and "nonfurnace" groups have been given in previous Coke and Byproducts chapters and therefore need not be repeated here. This classification is maintained by the Bureau in order that trends of activity for these two groups of plants may be followed.

"Furnace" plants, because of their close relationship to the iron and steel industry, normally follow the activity of this industry. Therefore, the output of coke from this group tends to fluctuate more than that of "nonfurnace" plants, depending on the demand for metallurgical fuel. For example, furnace plants in 1944 accounted for 78.9 percent of the total byproduct-coke production, compared with 53.8 percent for the depression year of 1932. Because of the large demand for coke during 1944, the average daily production rate for both groups remained relatively constant.

The recent expansion in blast-furnace capacity has increased greatly the requirements for metallurgical fuel, and production of coke from furnace plants has increased 46 percent since 1937, accompanied by a gain of 10 active plants. In the nonfurnace group, output in the same period increased 8 percent, although 6 fewer plants were active in 1944 than in 1937. The loss in production from these 6 plants (4 plants classified as nonfurnace in 1943 are now classified as medium- and low-temperature carbonization plants) was offset by new coke-oven construction at a number of nonfurnace plants active at the end of 1944.

TABLE 7.—Number and production of byproduct-coke plants connected with iron furnaces and of other plants in the United States, 1913, 1918, 1937, and 1943-44

Year	Number of active plants		Coke produced (net tons)		Percent of production	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
1913.....	20	16	9,277,832	3,436,868	73.0	27.0
1918.....	36	24	19,220,342	6,777,238	73.9	26.1
1937.....	43	42	36,134,209	13,076,539	73.4	26.6
1943.....	50	41	48,992,643	14,750,033	76.9	23.1
1944.....	53	35	62,919,844	14,144,951	78.9	21.1

TABLE 8.—Monthly and average daily production of byproduct coke by plants connected with iron furnaces and by all other plants in the United States, 1937 and 1943-44, in net tons

Month	1937		1943		1944	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
Monthly production:						
January.....	3,241,600	1,119,100	4,157,500	1,243,100	4,456,600	1,206,800
February.....	2,996,500	996,400	3,774,800	1,132,700	4,226,800	1,135,000
March.....	3,355,000	1,140,500	4,179,400	1,262,400	4,467,100	1,205,700
April.....	3,310,300	1,040,600	4,068,800	1,212,000	4,416,400	1,165,300
May.....	3,375,600	1,104,100	4,157,000	1,249,600	4,531,500	1,196,500
June.....	2,917,500	1,107,300	3,866,800	1,200,100	4,323,400	1,149,400
July.....	3,316,100	1,107,800	4,031,100	1,242,000	4,484,700	1,179,100
August.....	3,469,300	1,104,100	4,216,600	1,257,000	4,487,500	1,182,800
September.....	3,334,700	1,093,100	4,119,000	1,228,900	4,261,100	1,151,200
October.....	2,910,500	1,124,600	4,191,100	1,254,400	4,477,900	1,194,000
November.....	2,142,700	1,079,600	3,947,000	1,205,800	4,338,400	1,168,900
December.....	1,764,400	1,069,400	4,283,600	1,272,000	4,420,400	1,210,300
	36,134,200	13,076,600	48,992,700	14,750,000	52,919,800	14,145,000
Average daily production:						
January.....	104,600	36,100	134,100	40,100	143,800	38,900
February.....	107,000	35,600	134,800	40,500	145,700	39,200
March.....	108,200	36,800	134,800	40,400	144,800	38,900
April.....	110,300	34,700	135,600	40,400	147,200	38,800
May.....	108,900	35,600	134,100	40,300	146,200	38,600
June.....	97,800	36,900	128,900	40,000	144,100	38,300
July.....	107,000	35,700	130,000	40,100	144,700	38,000
August.....	111,900	35,600	136,000	40,600	144,700	38,200
September.....	111,200	36,400	137,300	41,000	142,000	38,400
October.....	93,900	36,300	135,200	40,500	144,600	38,500
November.....	71,400	36,000	131,600	40,200	144,600	39,000
December.....	56,900	34,200	138,200	41,000	142,900	39,000
Average.....	99,000	35,800	134,200	40,400	144,600	38,600

PRODUCTION BY STATES AND DISTRICTS

Reports received from 88 active byproduct-coke plants operating in 22 States in 1944 revealed that production increased in all but 4 States when compared with 1943. As in previous years, Pennsylvania led all producing States and contributed 25 percent of the byproduct total. This State, with Ohio, Indiana, New York, and Alabama, supplied 72 percent of the total for the country—approximately the same proportion as in 1943. The largest gains in tonnage over 1943 were attained in New York and Indiana, with increases of more than 700,000 tons each. Completion of the new byproduct plant by the Geneva Steel Co. in Utah increased production in that State by 207 percent over 1943. Texas became an active producer of byproduct coke in 1944 for the first time as the Lone Star Steel Co. and Sheffield

Steel of Texas started new ovens in the early part of the year. However, the Lone Star Steel Co. ceased operations on July 4, 1944, leaving only 1 plant active in Texas at the close of the year. Of the gain of 17.9 million tons in byproduct-coke output since 1937, Ohio, Indiana, and Pennsylvania together accounted for more than 57 percent of the total increase.

The decline in beehive blast-furnace coke requirements in 1944 resulted in a decrease in output in all but one of the beehive-producing States. As the preponderance of beehive coke comes from the famous Connellsville coal field of Pennsylvania, this State had the largest decrease in tonnage, with a drop of more than 750,000 tons from 1943 and 1.1 million tons from 1942—the peak year in beehive production in Pennsylvania since 1926. Marked decreases were also recorded in Utah, Virginia, West Virginia, and Tennessee, with the largest decrease in terms of percentage in Tennessee, where production dropped 82 percent.

TABLE 9.—Byproduct and beehive coke produced in the United States, 1937 and 1941–44, by States, in net tons

[Exclusive of screenings or breeze]

State	1937	1941	1942	1943	1944
Byproduct:					
Alabama	4,259,771	4,759,862	5,579,511	5,316,455	5,727,612
California				317,847	339,570
Colorado	496,945	622,807	676,209	672,502	650,511
Connecticut	(1)	(1)	(1)	(1)	(1)
Illinois	2,998,663	3,660,878	3,690,155	3,625,457	3,878,764
Indiana	5,467,061	7,406,724	7,337,512	8,111,916	8,821,021
Kentucky	(1)	(1)	(1)	(1)	(1)
Maryland	1,513,651	1,752,538	2,103,664	2,059,839	2,058,233
Massachusetts	1,130,620	1,161,732	1,176,359	1,174,152	1,177,850
Michigan	2,283,518	2,863,563	3,139,137	2,948,389	3,005,424
Minnesota	704,631	685,873	955,301	956,396	894,095
Missouri	(1)	(1)	(1)	(1)	(1)
New Jersey	1,015,073	1,031,569	1,038,461	1,014,268	1,022,917
New York	4,946,964	5,116,308	5,180,384	5,347,369	6,102,560
Ohio	6,737,881	9,284,194	9,912,783	10,270,758	10,338,913
Pennsylvania	13,701,262	15,632,354	16,310,167	16,518,872	16,976,574
Rhode Island	(1)	(1)	(1)	(1)	(1)
Tennessee	89,451	111,310	234,529	254,211	219,503
Texas					184,506
Utah	149,659	236,607	242,531	240,736	739,432
Washington	14,656			14,853	
West Virginia	1,817,993	1,983,619	2,444,368	2,611,825	2,637,591
Wisconsin	(1)	(1)	(1)	(1)	(1)
Combined States	1,892,949	2,172,484	2,273,838	2,286,831	2,289,719
	49,210,748	58,482,422	62,294,909	63,742,676	67,064,795
Beehive:					
Alabama		95,200	95,428	34,674	
Colorado	64,222	80,196	87,447	85,141	81,684
Kentucky		2,054	1,138	29,298	68,076
Pennsylvania	2,559,048	5,891,118	7,309,337	6,934,445	6,170,897
Tennessee	14,982	39,083	72,541	48,861	8,850
Utah	6,657	10,244	22,402	84,093	21,442
Virginia	240,425	324,573	350,521	293,324	243,116
West Virginia	279,387	261,688	335,221	423,551	378,957
	3,164,721	6,704,156	8,274,035	7,933,387	6,973,022
Grand total	52,375,469	65,186,578	70,568,944	71,676,063	74,037,817

¹ Included under "Combined States."

TABLE 10.—Coke produced, value, number of ovens, coal charged, and average yield in the United States in 1944, by States

[Exclusive of screenings or breeze]

State	Byproduct						Value of coke at ovens	
	Plants	Ovens	Coal charged (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)			
							Total	Per ton
Alabama	7	1,490	7,917,502	72.34	5,727,612		\$32,057,495	\$5.60
California	1	90	572,727	59.29	339,570		(1)	(1)
Colorado	1	188	1,011,316	64.32	650,511		(1)	(1)
Illinois	9	992	5,482,235	70.75	3,878,764		34,074,422	8.78
Indiana	5	1,856	12,061,943	73.13	8,821,021		74,079,053	8.40
Maryland	1	422	2,825,706	72.84	2,058,233		(1)	(1)
Massachusetts	2	215	1,671,001	70.49	1,177,850		(1)	(1)
Michigan	5	586	4,139,823	72.60	3,005,424		24,848,937	8.27
Minnesota	3	196	1,249,047	71.58	894,095		7,973,653	8.92
New Jersey	2	288	1,445,770	70.75	1,022,917		(1)	(1)
New York	8	1,142	8,636,787	70.66	6,102,560		47,155,591	7.73
Ohio	15	2,099	14,383,968	71.88	10,338,913		70,781,105	6.85
Pennsylvania	13	3,519	24,244,678	70.02	16,976,574		101,698,149	5.99
Tennessee	1	44	306,013	71.73	219,503		(1)	(1)
Texas	2	125	265,377	69.53	184,506		(1)	(1)
Utah	2	308	1,369,781	53.98	739,432		(1)	(1)
West Virginia	5	506	3,772,218	69.92	2,637,591		11,546,819	4.38
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	514	3,061,995	74.29	2,289,719		20,008,332	8.74
Undistributed							54,620,616	8.54
Total: 1944	88	14,580	94,437,887	71.01	67,064,795		478,844,172	7.14
1943	92	14,253	90,018,941	70.81	63,742,676		424,125,129	6.65

State	Beehive						Total	
	Ovens	Coal charged (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
					Total	Per ton		
Alabama							5,727,612	\$32,057,495
California							339,570	(1)
Colorado	260	124,966	65.36	81,684	(1)	(1)	732,195	(1)
Illinois							3,878,764	34,074,422
Indiana							8,821,021	74,079,053
Maryland							2,058,233	(1)
Massachusetts							1,177,850	(1)
Michigan							3,005,424	24,848,937
Minnesota							894,095	7,973,653
New Jersey							1,022,917	(1)
New York							6,102,560	47,155,591
Ohio							10,338,913	70,781,105
Pennsylvania	13,003	9,554,740	64.58	6,170,897	42,956,659	\$6.96	23,147,471	144,654,808
Tennessee	240	15,431	57.35	8,850	(1)	(1)	228,353	(1)
Texas							184,506	(1)
Utah	797	42,723	50.19	21,442	(1)	(1)	760,874	(1)
Virginia	753	415,362	58.53	243,116	1,895,243	7.80	243,116	1,895,243
West Virginia	1,065	602,073	62.94	378,957	2,708,821	7.15	3,016,548	14,255,640
Connecticut, Kentucky, Missouri, Rhode Is- land, and Wisconsin	200	103,140	66.00	68,076	476,531	7.00	2,357,795	20,484,863
Undistributed					1,040,080	9.29	55,660,006	
Total: 1944	16,318	10,658,435	64.22	6,973,022	49,077,334	7.04	74,037,817	527,921,806
1943	17,666	12,441,064	63.77	7,933,387	51,992,343	6.55	71,676,063	476,117,472

* Included under "Undistributed."

* Includes 4 medium- and low-temperature carbonization plants.

TABLE 11.—*Byproduct coke produced in the United States in 1944, by geographical districts in the iron and steel industry*

District	Plants	Ovens	Coal charged (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Eastern.....	22	3,432	23,205,641	71.15	16,511,407	\$134,085,785	\$8.12
Pittsburgh-Youngstown.....	16	3,601	26,122,858	70.36	18,380,985	101,969,401	5.55
Cleveland-Detroit.....	11	1,493	9,920,586	72.47	7,189,440	55,702,041	7.75
Chicago.....	20	3,303	19,973,868	72.52	14,484,238	124,895,193	8.62
Southern.....	15	2,165	12,261,110	71.52	8,769,212	46,732,247	5.33
Western.....	4	586	2,953,824	58.65	1,729,513	15,459,505	8.94
	88	14,580	94,437,887	71.01	67,064,795	478,844,172	7.14

TABLE 12.—*Byproduct and beehive coke produced in Pennsylvania in 1944, by districts*

District	Plants	Ovens	Coal charged (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Byproduct:							
Eastern Pennsylvania ¹	5	796	4,808,408	71.53	3,439,618	\$29,058,139	\$8.45
Western Pennsylvania ²	8	2,723	19,436,270	69.65	13,536,956	72,640,010	5.37
	13	3,519	24,244,678	70.02	16,976,574	101,698,149	5.99
Beehive:							
Fayette County.....	44	9,057	6,931,099	64.94	4,500,876	30,900,571	6.87
Westmoreland County.....	21	2,876	1,702,824	63.84	1,087,141	7,686,227	7.07
All other counties ³	5	1,070	920,817	63.30	582,880	4,369,861	7.50
	70	13,003	9,554,740	64.58	6,170,897	42,956,659	6.96
Grand total.....	83	16,522	33,799,418	68.48	23,147,471	144,654,808	6.25

¹ Includes plants at Bethlehem, Chester, Philadelphia, Steelton, and Swedeland.² Includes plants at Aliquippa, Clairton, Erie, Johnstown, Midland, Monessen, Neville Island, and Pittsburgh.³ Comprises figures from 1 plant each in Beaver, Cambria, and Greene Counties and 2 plants in Indiana County.

NUMBER AND TYPE OF OVENS

Byproduct ovens.—The tremendous wartime construction program in the byproduct-coke industry was virtually completed in 1944, when the number of new ovens contracted for and placed in operation since 1939 totaled 1,973 with a maximum annual coke capacity of 10,651,300 tons. An analysis of the new ovens built since 1939 shows that 1,638 new ovens with a yearly coke capacity of 8,924,000 tons have been built for companies directly engaged in the production of iron and steel. The remainder have been built for merchant plants or for gas companies, from which coke and gas is manufactured for industrial and domestic use. In addition to new ovens, 14 batteries consisting of 758 ovens have been completely rebuilt since 1939, raising the number of new and rebuilt ovens to 2,731. Of the 14,580 byproduct ovens reported in existence at the end of 1944, 40 percent were Koppers-Becker, 36 percent Koppers, 14 percent Semet-Solvay, 9 percent Wilputte, and the remaining 1 percent other miscellaneous types.

Beehive ovens.—Beehive-coke ovens have furnished an important part of the Nation's blast-furnace coke requirements during World War II. At the beginning of our defense program, when steel demand was surging and coke requirements for blast-furnace use were hitting new highs, beehive ovens—long-abandoned—were hurriedly rebuilt and placed in operation to supplement byproduct-plant deficiencies. Thus, in April 1939, an average of 990 beehive ovens was in active operation; the number increased steadily until a peak of 13,819 was reached in September 1943. However, the cut-back in pig-iron production in 1944, coupled with increased byproduct-coke output, reduced the requirements for beehive blast-furnace coke, and a number of ovens were shut down and some were again abandoned. The average number of active beehive ovens in December 1944 amounted to 9,084 (32 percent) less than in the peak month of January 1944.

TABLE 13.—Coke ovens completed and abandoned in the United States in 1944 and total number in existence at end of year, by States

State	Plants in existence Dec. 31	Ovens						
		In existence Dec. 31		New		Abandoned during year	Under construction Dec. 31	
		Number	Annual capacity (net tons of coke)	Number	Annual capacity (net tons of coke)		Number	Annual capacity (net tons of coke)
Byproduct:								
Alabama	8	1,490	6,833,500					
California	1	90	360,000					
Colorado	1	188	813,000				74	327,000
Connecticut	1	70	(1)					
Illinois	9	992	4,474,800	75	405,000			
Indiana	5	1,856	9,538,000					
Kentucky	1	120	(1)					
Maryland	1	422	2,124,000					
Massachusetts	2	215	1,289,800					
Michigan	5	586	3,084,100			55		
Minnesota	3	196	985,600					
Missouri	1	64	(1)					
New Jersey	2	288	1,377,000	65	360,000	3		
New York	8	1,142	6,234,500			3		
Ohio	15	2,099	10,617,000					
Pennsylvania	13	3,519	17,473,000				106	708,100
Rhode Island	1	65	(1)					
Tennessee	1	44	242,000					
Texas	2	125	712,000	125	712,000			
Utah	2	308	1,202,800	189	728,000			
West Virginia	5	506	2,682,500					
Wisconsin	2	195	(1)					
Undistributed			2,286,000					
	89	14,580	72,330,200	454	2,205,000	61	180	1,035,100
At merchant plants	36	3,344	15,344,700	65	360,000	61		
At furnace plants	53	11,236	56,985,500	389	1,845,000		180	1,035,100
Beehive:								
Alabama						494		
Colorado	1	260	130,000					
Kentucky	1	200	180,000					
Pennsylvania	70	13,003	8,663,434	29	14,500	700		
Tennessee	2	240	100,200					
Utah	2	797	430,000					
Virginia	5	753	390,800	2	1,000			
West Virginia	10	1,065	543,952			185		
	91	16,318	10,438,386	31	15,500	1,379		

¹ Included under "Undistributed."

² Rebuilt ovens.

TABLE 14.—Average number of beehive ovens active in the United States in 1944, by months

Month	Number	Month	Number	Month	Number
January.....	13,374	May.....	11,610	September.....	10,553
February.....	12,776	June.....	11,478	October.....	10,261
March.....	12,248	July.....	11,733	November.....	9,799
April.....	11,834	August.....	11,577	December.....	9,084

CAPACITY OF BYPRODUCT PLANTS

Tables 15 and 16 show the potential maximum annual coke capacity of all ovens in existence, whether idle or active, and the relationship between capacity and production for 1937 and 1941-44. The basis upon which potential maximum capacity of a coke plant is established is the minimum coking time at which the ovens can be operated to produce coke with qualities suitable for the use for which it is intended. This may differ from the rated capacity of a coke-oven plant, which is the number of tons of coke per year that the plant is designed to produce. Potential maximum annual coke capacity, as thus stated, is subject to change from year to year, depending on the age and condition of ovens, character and quality of coal charged, and economic and labor conditions.

The potential maximum daily capacity of the 89 byproduct-coke plants in existence December 31, 1944, both idle and active, was 197,623 tons. The daily capacity of furnace plants was 155,698 tons; operation was at 89.4 percent of capacity. That of merchant plants was 41,925 tons; operation was at 90.8 percent of capacity. The operating ratio for the year was slightly lower than for either 1942 or 1943 because many of the older batteries at various steel plants that have been operating at top speed during the war period required longer coking periods to avoid serious damage to old brickwork in the oven walls. As will be noted in table 16, the rate of production may fluctuate widely with variations in the activity of the heavy industries.

TABLE 15.—Potential maximum annual coke capacity of all byproduct coke ovens in existence in the United States, 1937 and 1941-44

Year	Number of plants	Number of ovens	Potential maximum annual coke capacity (net tons)	Percent of change from 1937
1937.....	87	12,718	62,727,075	-----
1941.....	87	13,016	62,562,348	-0.3
1942.....	88	13,303	64,554,972	+2.9
1943.....	92	14,253	71,378,408	+13.8
1944.....	89	14,580	72,330,200	+15.3

TABLE 16.—*Relationship of production to potential maximum capacity¹ at byproduct-coke plants in the United States, 1937 and 1941-44, by months, in percent*

Month	1937	1941	1942	1943	1944	Month	1937	1941	1942	1943	1944
January.....	83.0	92.0	94.3	98.7	95.8	August.....	86.0	93.4	98.0	96.3	91.1
February.....	83.5	92.9	94.2	98.8	96.6	September.....	86.1	91.9	98.4	96.7	89.8
March.....	84.9	93.2	94.3	98.0	95.7	October.....	76.0	92.0	98.4	94.7	91.1
April.....	84.9	86.4	94.3	98.0	96.2	November.....	62.8	92.1	98.9	90.7	90.8
May.....	84.6	90.6	98.1	96.4	95.5	December.....	53.1	94.8	98.4	94.2	89.7
June.....	78.6	93.3	98.3	92.6	94.3						
July.....	83.2	93.7	97.6	93.3	91.5	The year.....	78.8	92.2	96.9	95.7	93.1

¹ Capacity of all ovens in existence, whether active or idle, based upon maximum daily capacity times days in month.

QUANTITY AND COST OF COAL CHARGED

Wartime expansion in coal-carbonizing capacity has increased greatly the requirements for coking coal, and in 1944 more than one-sixth of the total output of bituminous coal was consumed in byproduct- and beehive-coke ovens. The quantity charged into byproduct ovens increased 5 percent over the previous record figure in 1943 and reached a new high of 94,437,887 tons. The quantity carbonized in byproduct ovens, by months, in 1944 was rather uniform and illustrated the continuity of operations. The diminished requirements for beehive coke in 1944 resulted in a decrease of 13 percent in beehive coal consumption, and the quantity consumed each month dropped steadily, so that in December the quantity used was 41 percent lower than in January.

Table 18 shows the quantity of coal charged into ovens in each State and the value at the oven. The cost of coal constitutes the chief expense in the manufacture of coke, and it may vary widely, depending chiefly on the location of the coke plant, with relation to its sources of coal—in other words, in cost of transportation. In 1944, the total value of coal f. o. b. ovens increased 11 percent over 1943 and ranged from \$2.91 in Virginia where beehive coke is made at the mines, to \$6.35 in Minnesota where the cost includes transportation charges from distant mines.

Table 20 shows the cost of coal and value of all products per ton of coke produced. In 1944, the value of beehive coke per ton as reported by operators was \$7.04, whereas the cost of coal charged into ovens per ton of coke drawn was \$5.15. It is not to be assumed that the margin of \$1.89 between these two figures represents the profit realized by the operator. Although coal is the major item of cost, there are other expenses, such as labor, allowance for depreciation of plant equipment, and taxes, that must be charged off before any profit can be shown.

Under market conditions that have prevailed during the past few years, the cost of coal used at byproduct-coke plants has exceeded the value of the coke produced. It will be noted that virtually all of the increase in cost of coal has been absorbed by the increase in value of coke produced, as the value of the byproducts per ton of coke produced has declined since 1937. No data on total costs or profits have been collected, but the table indicates clearly the trend of the market.

TABLE 17.—*Coal consumed in coke ovens in the United States, 1937 and 1943-44, by months, in net tons*

Month	1937			1943			1944		
	Byproduct	Beehive	Total	Byproduct	Beehive	Total	Byproduct	Beehive	Total
January.....	6,198,700	426,600	6,625,300	7,647,600	1,038,300	8,685,900	7,969,300	1,064,400	9,033,700
February.....	5,679,900	458,500	6,138,400	6,937,700	1,048,700	7,986,400	7,534,000	1,006,500	8,540,500
March.....	6,387,000	556,800	6,943,800	7,613,600	1,179,200	8,792,800	8,071,100	1,041,400	9,112,500
April.....	6,183,800	480,800	6,664,600	7,461,200	1,073,900	8,535,100	7,885,500	957,000	8,842,500
May.....	6,368,500	509,700	6,878,200	7,640,900	1,028,400	8,669,300	8,089,000	1,001,600	9,090,600
June.....	5,729,200	430,500	6,159,700	7,153,200	657,900	7,811,100	7,728,600	954,000	8,682,600
July.....	6,217,200	441,700	6,658,900	7,457,300	967,200	8,424,500	7,949,100	940,000	8,889,100
August.....	6,425,800	401,100	6,826,900	7,733,600	1,119,500	8,853,100	7,960,200	891,400	8,851,600
September.....	6,220,700	392,800	6,613,500	7,575,200	1,116,300	8,691,500	7,588,400	800,900	8,389,300
October.....	5,664,800	351,600	6,016,400	7,673,300	1,146,200	8,819,500	7,966,800	817,700	8,784,500
November.....	4,527,000	284,000	4,791,000	7,292,000	953,000	8,245,000	7,730,600	754,600	8,485,200
December.....	3,972,800	212,700	4,185,500	7,833,300	1,112,500	8,945,800	7,965,300	628,900	8,594,200
	69,575,400	4,926,800	74,502,200	90,018,900	12,441,100	102,460,000	94,437,900	10,858,400	105,296,300

TABLE 18.—*Total quantity and value at ovens of coal used in manufacturing coke in the United States in 1944, by States*

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Average	Net tons	Cost
Byproduct:					
Alabama.....	7,917,502	\$31,906,486	\$4.03	1.38	\$5.56
California.....	572,727	(1)	(1)	1.69	(1)
Colorado.....	1,011,316	(1)	(1)	1.55	(1)
Illinois.....	5,482,235	33,110,447	6.04	1.41	8.52
Indiana.....	12,061,943	73,707,487	6.11	1.37	8.37
Maryland.....	2,825,706	(1)	(1)	1.37	(1)
Massachusetts.....	1,671,001	(1)	(1)	1.42	(1)
Michigan.....	4,139,823	22,323,996	5.39	1.38	7.44
Minnesota.....	1,249,047	7,926,428	6.35	1.40	8.89
New Jersey.....	1,445,770	(1)	(1)	1.41	(1)
New York.....	8,636,787	50,777,122	5.88	1.42	8.35
Ohio.....	14,383,968	72,299,434	5.03	1.39	6.99
Pennsylvania.....	24,244,678	103,811,816	4.28	1.43	6.12
Tennessee.....	306,013	(1)	(1)	1.39	(1)
Texas.....	265,377	(1)	(1)	1.44	(1)
Utah.....	1,369,781	(1)	(1)	1.85	(1)
West Virginia.....	3,772,218	12,516,027	3.32	1.43	4.75
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	3,081,995	17,619,177	5.72	1.35	7.72
Undistributed.....		54,199,091	5.72	-----	8.47
	94,437,887	490,197,510	5.08	1.41	7.16
At merchant plants.....	19,559,111	110,319,049	5.64	1.38	7.78
At furnace plants.....	74,878,776	369,878,461	4.94	1.41	6.97
Beehive:					
Colorado.....	124,966	(1)	(1)	1.53	(1)
Kentucky.....	103,140	(1)	(1)	1.51	(1)
Pennsylvania.....	9,654,740	31,506,202	3.30	1.55	5.12
Tennessee.....	15,431	(1)	(1)	1.74	(1)
Utah.....	42,723	(1)	(1)	1.99	(1)
Virginia.....	415,362	1,206,971	2.91	1.71	4.98
West Virginia.....	602,073	1,933,143	3.21	1.59	5.10
Undistributed.....		1,185,157	4.14	-----	6.58
	10,858,435	35,831,473	3.30	1.56	5.15

¹ Included under "Undistributed."

TABLE 19.—Average cost per net ton of coal charged into byproduct-coke ovens in the United States, 1937 and 1941-44, by States

State	1937	1941	1942	1943	1944	State	1937	1941	1942	1943	1944
Alabama.....	\$2.33	\$2.79	\$3.13	\$3.60	\$4.03	Tennessee.....	\$3.42	\$3.67	(¹)	(¹)	(¹)
Illinois.....	4.62	4.92	5.28	5.62	6.04	Washington.....	4.87	—	—	(¹)	—
Indiana.....	4.71	5.16	5.50	5.85	6.11	West Virginia.....	2.54	2.63	\$2.92	\$3.19	\$3.32
Massachusetts.....	(¹)	(¹)	(¹)	(¹)	(¹)	United States average.....	3.74	3.92	4.38	4.75	5.08
Michigan.....	4.16	4.35	4.87	4.57	5.39	Cost of coal per ton of coke.....	5.27	5.53	6.18	6.70	7.16
Minnesota.....	5.24	5.19	5.64	6.02	6.35						
New York.....	4.55	4.87	5.37	5.59	5.88						
Ohio.....	3.76	4.13	4.41	4.73	5.03						
Pennsylvania.....	2.98	2.69	3.44	3.96	4.28						

¹ Bureau of Mines not at liberty to publish data.

TABLE 20.—Cost of coal and value of all products per net ton of coke produced in the United States, 1918, 1929, 1939, and 1944

Year	Byproduct				Beehive	
	Cost of coal per ton of coke	Value per ton of coke produced			Cost of coal per ton of coke	Value of coke per ton
		Coke	Byproducts	Total		
1918.....	\$6.00	\$7.42	\$3.08	\$10.50	\$3.65	\$6.21
1929.....	5.04	4.80	3.56	8.36	2.85	3.49
1936.....	5.24	5.06	3.01	8.07	2.94	3.91
1937.....	5.27	5.03	2.97	8.00	3.14	4.31
1938.....	5.61	5.16	3.53	8.69	3.32	4.42
1939.....	5.36	4.82	3.19	8.01	3.16	4.45
1940.....	5.23	4.82	2.90	7.81	3.12	4.41
1941.....	5.53	5.41	2.98	8.39	3.66	5.44
1942.....	6.18	6.07	3.10	9.17	3.93	5.75
1943.....	6.70	6.65	3.13	9.78	4.77	6.55
1944.....	7.16	7.14	3.10	10.24	5.16	7.04

PREPARATION AND SOURCE OF COAL

Washed and unwashed.—The quality of coal received is of paramount importance to the coke industry, for quality directly affects the yield, calorific value, and quality of coke and also materially affects efficient operation of the plant and costs of manufacture.⁸ Coals available for coke manufacture that contain an undue proportion of ash, sulphur, or other impurities are usually cleaned before being charged into ovens. In 1944, 32 byproduct- and 12 beehive-coke plants used coal that had been cleaned at mines, and 6 byproduct-coke plants charged into their ovens coal that was cleaned at the ovens. The quantity of washed coal charged into byproduct ovens increased 11 percent over 1943 and accounted for 28 percent of the total coal charged. Although the total amount of coal consumed in beehive ovens in 1944 declined from 1943, the quantity of washed coal charged increased 9 percent and was equivalent to 13 percent of the total compared with 11 percent for the preceding year.

⁸ Brown, W. T., *Necessity for Coal Cleaning: Blast Furnace and Steel Plant*, April 1944, pp. 457, 458, 482, and 483, and May 1944, pp. 557-561.

TABLE 21.—*Washed and unwashed coal used in manufacturing coke in the United States in 1944, by States in which used, in net tons*

State	Byproduct				Beehive		
	Bituminous		Anthra- cite	Total	Bituminous		
	Washed	Unwashed			Washed	Un- washed	Total
Alabama.....	7,689,499	228,003	-----	7,917,502	-----	-----	-----
California.....	417,703	155,024	-----	572,727	-----	-----	-----
Colorado.....	1,011,316	-----	-----	1,011,316	124,966	-----	124,966
Illinois.....	854,922	4,593,436	33,877	5,482,235	-----	-----	-----
Indiana.....	-----	12,061,943	-----	12,061,943	-----	-----	-----
Maryland.....	-----	2,825,706	-----	2,825,706	-----	-----	-----
Massachusetts.....	-----	1,671,001	-----	1,671,001	-----	-----	-----
Michigan.....	275,780	3,826,043	38,000	4,139,823	-----	-----	-----
Minnesota.....	-----	1,249,047	-----	1,249,047	-----	-----	-----
New Jersey.....	-----	1,445,770	-----	1,445,770	-----	-----	-----
New York.....	1,010,768	7,626,019	-----	8,636,787	-----	-----	-----
Ohio.....	3,659,003	10,724,965	-----	14,383,968	-----	-----	-----
Pennsylvania.....	9,891,387	14,258,523	94,768	24,244,678	1,306,204	8,248,536	9,554,740
Tennessee.....	219,196	86,817	-----	306,013	15,431	-----	15,431
Texas.....	265,377	-----	-----	265,377	-----	-----	-----
Utah.....	-----	1,369,781	-----	1,369,781	16,239	26,484	42,723
Virginia.....	-----	-----	-----	-----	-----	415,362	415,362
West Virginia.....	1,238,910	2,529,589	3,719	3,772,218	-----	602,073	602,073
Connecticut, Kentucky, Missouri, Rhode Is- land, and Wisconsin.....	-----	3,063,923	18,072	3,081,995	-----	103,140	103,140
	26,533,861	67,715,590	188,436	94,437,887	1,462,840	9,395,595	10,858,435
At merchant plants.....	1,724,882	17,791,923	42,306	19,559,111	-----	-----	-----
At furnace plants.....	24,808,979	49,923,667	146,130	74,878,776	-----	-----	-----

Sources.—The Appalachian region extending from Alabama to Pennsylvania is the greatest reservoir of coking coal in the United States and supplied four-fifths of all coal used in the manufacture of byproduct coke in 1944. The principal States, in tonnage of coal furnished to byproduct-coke-oven operators in 1944, were Pennsylvania, supplying 37 percent; West Virginia, 35 percent; Kentucky, 14 percent; and Alabama, 8 percent. Although West Virginia ranked second to Pennsylvania in tonnage purchased, the distribution of its coal was far more widespread and moved to 17 other States. The principal consumer of Kentucky coal was Indiana, which received 44 percent of its total requirements from that State. The tremendous expansion in coal-carbonizing equipment in the Far West in 1944 accounts for the 87-percent increase in coking coal from Utah. Arkansas and Oklahoma were added to the list of States supplying coking coal.

TABLE 22.—*Coal purchased for manufacturing byproduct coke in the United States in 1944, by fields of origin, in net tons*

State and district where coal was produced	Total purchased	States where coal was consumed—in order of importance
Alabama.....	7,927,362	Alabama.
Arkansas.....	41,288	California and Utah.
Colorado.....	892,411	Colorado.
Illinois.....	145,658	Illinois, Indiana, and Pennsylvania.
Indiana.....	34,067	Wisconsin and Illinois.
Kentucky:		
Elkhorn.....	4,534,052	Indiana, Ohio, Illinois, New York, Pennsylvania, Michigan, New Jersey, Minnesota, Wisconsin, Massachusetts, Connecticut, and Kentucky.
Harlan.....	6,167,432	Indiana, Illinois, Ohio, Minnesota, Pennsylvania, and Tennessee.
Thacker.....	2,442,811	Michigan, Ohio, and Wisconsin.
Miscellaneous.....	264,891	Illinois.
New Mexico.....	259,490	Colorado.
Oklahoma.....	278,953	Texas, California, and Utah.
Pennsylvania:		
Anthracite.....	214,860	Michigan, Pennsylvania, New York, Illinois, Missouri, Wisconsin, and West Virginia.
Butler-Mercer.....	88,782	Ohio, Illinois, and Indiana.
Central Pennsylvania:		
High-volatile.....	596,592	New York, Illinois, and Pennsylvania.
Medium-volatile.....	361,076	New York, Maryland, and Pennsylvania.
Low-volatile.....	3,220,904	Pennsylvania, New York, Ohio, and Maryland.
Connellsville.....	15,533,652	Pennsylvania, Ohio, West Virginia, Illinois, New York, and Minnesota.
Freeport.....	2,303,110	Ohio, West Virginia, Pennsylvania, and Michigan.
Pittsburgh.....	11,764,933	Pennsylvania, New York, Ohio, Michigan, Wisconsin, and Illinois.
Somerset.....	483,593	Pennsylvania, West Virginia, New York, and Ohio.
Westmoreland.....	1,258,643	Pennsylvania and Maryland.
Tennessee.....	225,041	Tennessee.
Utah.....	1,909,495	Utah and California.
Virginia.....	1,026,913	Ohio, Michigan, New Jersey, and New York.
West Virginia:		
Clinch Valley.....	81,393	Massachusetts.
Coal and Coke.....	6,060	Pennsylvania.
Coal River.....	178,984	Illinois, New Jersey, and Michigan.
Kanawha.....	7,448,187	Ohio, Illinois, Kentucky, Massachusetts, Indiana, West Virginia, Pennsylvania, Wisconsin, New York, Connecticut, Missouri, Minnesota, Michigan, New Jersey, Rhode Island, and Maryland.
Logan.....	2,143,195	Indiana, Ohio, Michigan, Massachusetts, New York, Illinois, Minnesota, Connecticut, and Pennsylvania.
New River:		
High-volatile.....	883,865	New York, New Jersey, Rhode Island, Connecticut, Illinois, and Pennsylvania.
Medium-volatile.....	1,190,690	New Jersey, Massachusetts, Connecticut, Michigan, and New York.
Low-volatile.....	903,101	New Jersey, Maryland, New York, Minnesota, and Pennsylvania.
Northern.....	5,380,349	Pennsylvania, Maryland, West Virginia, Ohio, Michigan, and New York.
Pocahontas ¹	13,414,984	Indiana, Ohio, Illinois, Michigan, New York, Pennsylvania, Minnesota, Wisconsin, Kentucky, Connecticut, Missouri, Alabama, Maryland, Rhode Island, and Tennessee.
Tug River.....	280,348	Maryland.
Webster-Gauley.....	809,329	Pennsylvania, New York, Maryland, and Wisconsin.
Williamson ¹	63,925	Indiana.
Winding Gulf.....	1,176,871	Massachusetts, Ohio, Michigan, New York, Illinois, West Virginia, Rhode Island, and Pennsylvania.
	95,939,290	

¹ 1,134,816 tons of Pocahontas and 63,925 tons of Williamson coal produced in Virginia are included in the Pocahontas and Williamson fields of West Virginia.

TABLE 23.—Coal purchased for manufacturing byproduct coke in the United States in 1944, by States where produced and where consumed and by merchant and furnace plants, in net tons

State where coal was consumed	Coal produced in—													
	Alabama	Arkansas	Colorado	Illinois	Indiana	Kentucky	New Mexico	Oklahoma	Pennsylvania	Tennessee	Utah	Virginia	West Virginia	Total
Alabama:														
Merchant plants.....	1,025,274												112,033	1,137,307
Furnace plants.....	6,902,088												6,725	6,908,813
Total Alabama.....	7,927,362													
California: Furnace plant.....		38,662						8,937			541,007		118,758	8,046,120
Colorado: Furnace plant.....			892,411				259,490							1,151,901
Illinois:														
Merchant plants.....				141,067	15,948	41,297			21,235				760,060	822,592
Furnace plants.....				141,067	15,948	1,857,561			493,854				2,068,574	4,607,004
Total Illinois.....				141,067	15,948	1,898,858			515,089				2,838,634	5,429,596
Indiana:														
Merchant plants.....						5,279,467			15,180			58,522	1,015,024	1,073,546
Furnace plants.....				4,493								978,130	4,781,704	11,053,974
Total Indiana.....				4,493		5,279,467			15,180			1,036,652	5,796,728	12,132,520
Maryland: Furnace plant.....									86,348				2,781,490	2,867,838
Massachusetts: Merchant plants.....						15,977							1,651,879	1,667,856
Michigan:														
Merchant plants.....						66,833			331,697			144,557	631,392	1,174,479
Furnace plants.....						2,155,743			348,408			214,576	1,061,371	3,780,098
Total Michigan.....						2,222,576			680,105			359,133	1,692,763	4,954,577
Minnesota:														
Merchant plant.....						62,130							378,751	440,881
Furnace plants.....						569,146			80,851				190,085	840,082
Total Minnesota.....						631,276			80,851				568,836	1,280,963
New Jersey: Merchant plants.....						114,379						176,342	1,188,575	1,479,296
New York:														
Merchant plants.....						338,208			1,860,232			120,451	1,908,197	4,247,088
Furnace plants.....									3,746,282			143,541	613,541	4,504,164
Total New York.....						338,208			5,606,514			263,992	2,522,338	8,751,252

TABLE 24.—Coal purchased for manufacturing byproduct coke in the United States in 1944, by States where consumed and by volatile content ¹

State where coal was consumed	Low-volatile		Medium-volatile		High-volatile		Total coal purchased (net tons)
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	
Alabama:							
Merchant plants.....	112,033	9.9	537,122	47.2	488,152	42.9	1,137,307
Furnace plants.....	6,725	.1	6,571,956	95.1	330,132	4.8	6,908,813
Total Alabama.....	118,758	1.5	7,109,078	88.4	818,284	10.1	8,046,130
California: Furnace plant.....	47,599	8.1			641,007	91.9	588,606
Colorado: Furnace plant.....					1,151,901	100.0	1,151,901
Illinois:							
Merchant plants.....	241,839	29.4	393,034	47.8	187,719	22.8	822,592
Furnace plants.....	1,524,388	33.1			3,082,616	66.9	4,607,004
Total Illinois.....	1,766,227	32.5	393,034	7.3	3,270,335	60.2	5,429,596
Indiana:							
Merchant plants.....	389,319	36.3	684,227	63.7			1,073,546
Furnace plants.....	5,052,558	45.7	15,180	.1	5,991,236	54.2	11,058,974
Total Indiana.....	5,441,877	44.8	699,407	5.8	5,991,236	49.4	12,132,520
Maryland: Furnace plant.....	703,546	24.5	809,724	28.2	1,354,568	47.3	2,867,838
Massachusetts: Merchant plants.....	330,177	19.8	447,369	26.8	890,310	53.4	1,667,856
Michigan:							
Merchant plants.....	363,740	31.0	65,739	5.6	745,000	63.4	1,174,479
Furnace plants.....	697,126	18.4			3,082,972	81.6	3,780,098
Total Michigan.....	1,060,866	21.4	65,739	1.3	3,827,972	77.3	4,954,577
Minnesota:							
Merchant plant.....	120,224	27.3	36,838	8.3	283,819	64.4	440,881
Furnace plants.....	190,085	22.6			649,997	77.4	840,082
Total Minnesota.....	310,309	24.2	36,838	2.9	933,816	72.9	1,280,963
New Jersey: Merchant plants.....	337,877	22.8	467,105	31.6	674,314	45.6	1,479,296
New York:							
Merchant plants.....	494,102	11.6	397,942	9.4	3,355,044	79.0	4,247,088
Furnace plants.....	1,327,104	29.5	36,687	.8	3,140,373	69.7	4,504,164
Total New York.....	1,821,206	20.8	434,629	5.0	6,495,417	74.2	8,751,252
Ohio:							
Merchant plants.....	481,966	29.4	137,313	8.4	1,018,565	62.2	1,637,844
Furnace plants.....	3,130,632	24.6	483,392	3.8	9,103,754	71.6	12,717,778
Total Ohio.....	3,612,598	25.2	620,705	4.3	10,122,319	70.5	14,355,622
Pennsylvania:							
Merchant plants.....	159,890	18.6	297,546	34.6	401,915	46.8	859,351
Furnace plants.....	2,850,821	12.1	61,230	.2	20,694,600	87.7	23,606,651
Total Pennsylvania.....	3,010,711	12.3	358,776	1.5	21,096,515	86.2	24,466,002
Tennessee: Merchant plant.....	18,548	6.0	225,041	72.1	68,399	21.9	311,988
Texas: Furnace plants.....	8,531	3.2	98,524	37.1	158,322	59.7	265,377
Utah: Furnace plants.....	7,265	.5			1,368,488	99.5	1,375,753
West Virginia:							
Merchant plants.....	74,754	5.0	1,834	.1	1,428,382	94.9	1,504,970
Furnace plants.....	187,690	8.6			2,001,430	91.4	2,189,120
Total West Virginia.....	262,444	7.1	1,834	.1	3,429,812	92.8	3,694,090
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants.....	797,961	25.6	233,953	7.5	2,088,019	66.9	3,119,933
Total.....	19,656,500	20.5	12,001,756	12.5	64,281,034	67.0	95,939,290
At merchant plants.....	3,922,430	20.1	3,925,063	20.2	11,629,638	59.7	19,477,131
At furnace plants.....	15,734,070	20.6	8,076,693	10.6	52,651,396	68.8	76,462,159

¹Low-volatile—dry V. M. 22 percent or less and more than 14 percent; medium-volatile—dry V. M. 31 percent or less and more than 22 percent; high-volatile—dry V. M. more than 31 percent.

Blending.—During 1944, 75 of the 88 active byproduct-coke plants purchased coals of different volatile content. Both high- and low-volatile coals were purchased by 45 plants; high-, medium-, and low-volatile by 25 plants; high- and medium-volatile by 3 plants; and medium- and low-volatile by 2 plants. In addition, 9 plants used anthracite fines in their coal mix. Of the 13 plants that did not purchase coals of different volatile content, 10 purchased high-volatile and 3 medium-volatile coal. Table 24 shows the purchases, by States, of the coals used in the manufacture of byproduct coke, classified as to volatile content. In 1944, of the 95,939,290 tons of coking coals purchased, 67 percent was high-volatile, 13 percent medium-volatile, and 20 percent low-volatile, approximately the same ratio as for 1943.

YIELD OF COKE PER TON OF COAL

TABLE 25.—Yield of coke from coal in byproduct and beehive ovens in the United States, 1937 and 1942-44 by States, in percent

State	1937		1942		1943		1944	
	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive
Alabama.....	72.37	-----	71.71	61.45	72.48	59.66	72.34	-----
California.....	-----	-----	-----	-----	58.62	-----	59.29	-----
Colorado.....	67.36	55.71	66.24	63.87	63.71	64.34	64.32	65.36
Illinois.....	70.64	-----	70.63	-----	70.15	-----	70.75	-----
Indiana.....	72.04	-----	72.31	-----	72.75	-----	73.13	-----
Maryland.....	72.62	-----	72.42	-----	72.78	-----	72.84	-----
Massachusetts.....	69.99	-----	70.49	-----	70.62	-----	70.49	-----
Michigan.....	71.05	-----	72.00	-----	72.03	-----	72.60	-----
Minnesota.....	70.27	-----	75.17	-----	74.41	-----	71.58	-----
New Jersey.....	70.78	-----	72.16	-----	71.64	-----	70.75	-----
New York.....	71.75	-----	71.40	-----	71.50	-----	70.66	-----
Ohio.....	71.61	-----	72.18	-----	71.97	-----	71.88	-----
Pennsylvania.....	68.83	65.50	68.27	64.73	68.27	64.55	70.02	64.58
Tennessee.....	69.00	53.89	71.10	59.01	71.14	59.43	71.73	57.35
Texas.....	-----	-----	-----	-----	-----	-----	69.53	-----
Utah.....	56.67	54.25	59.87	51.07	58.99	43.51	53.98	50.19
Virginia.....	-----	58.33	-----	59.96	-----	58.63	-----	58.53
Washington.....	56.11	-----	-----	-----	65.32	-----	-----	-----
West Virginia.....	70.67	61.74	69.78	62.31	70.72	61.89	69.92	62.94
United States average.....	70.73	64.23	70.81	64.25	70.81	63.77	71.01	64.22

COKE BREEZE
TABLE 26.—Coke breeze recovered at coke plants in the United States in 1944, by States

State	Yield per ton of coal (per cent) ¹	Produced		Used by producer				Wasted (net tons)	On hand Dec. 31 (net tons)	
		Net tons	Value	For steam raising		For other purposes including water gas				
				Net tons	Value	Net tons	Value			
										Net tons	Value
Byproduct:										
Alabama.....	3.85	304,614	\$880,239	142,355	\$282,831	46,137	\$125,022	122,570	9,601	
California.....	6.91	39,999	(²)	33,085	(²)	26,915	(²)	8,625	37,841	
Colorado.....	9.19	92,893	(²)	33,085	(²)	38,361	(²)	16,366	9,099	
Illinois.....	6.83	374,335	1,161,636	193,436	546,707	17,943	41,368	100,651	129,480	
Indiana.....	5.07	612,125	1,881,480	390,238	1,216,033	92,731	252,220	132,240	225,560	
Maryland.....	7.20	203,404	(²)	58,401	(²)	27,200	(²)	77,448	209,078	
Massachusetts.....	7.75	129,514	(²)	110,667	(²)	5,508	(²)	2,945	24,616	
Michigan.....	5.32	220,203	784,839	140,758	454,975	20,466	75,014	44,055	37,687	
Minnesota.....	6.09	83,381	273,898	47,238	143,850	5,670	17,536	31,738	38,975	
New Jersey.....	6.74	97,410	33,022	93,022	(²)	(²)	(²)	31,321	7,937	
New York.....	5.51	475,753	1,430,297	348,554	1,038,938	60,947	186,850	48,906	106,243	
Ohio.....	5.51	792,603	1,897,023	424,119	924,660	268,437	621,271	149,820	90,453	
Pennsylvania.....	4.42	1,071,669	2,269,184	1,084,017	2,419,721	74,284	135,304	102,453	439,711	
Tennessee.....	3.90	11,922	(²)	1,338	(²)	(²)	(²)	8,686	7,362	
Texas.....	3.01	7,980	(²)	66,760	(²)	3,493	(²)	3,487	1,000	
Utah.....	9.81	134,388	(²)	99,611	156,178	26,104	29,371	46,113	71,960	
West Virginia.....	4.01	126,326	206,502	66,760	(²)	18,516	29,371	17,277	19,228	
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin.....	6.06	186,745	583,651	147,318	440,066	311	638	44,486	25,953	
Undistributed.....			1,882,963		902,955		291,279	511,401		
Total, 1944.....	5.29	4,965,064	13,281,342	3,350,917	8,526,914	732,183	1,775,873	1,018,147	1,491,784	
At merchant plants.....	5.65	1,070,791	3,377,696	805,878	2,343,203	47,794	148,821	197,642	192,439	
At furnace plants.....	5.20	3,894,273	9,903,646	2,545,039	6,183,711	684,389	1,627,052	820,505	1,299,345	
Total, 1943.....	5.40	4,789,569	12,206,564	3,098,273	7,465,961	617,511	1,611,284	1,291,909	1,278,220	
Beehive:										
Colorado.....	4.61	5,760	(²)	19,757	23,204	5,760	(²)	81,705	6,903	
Pennsylvania.....	3.77	141,886	150,886	(²)	(²)	(²)	(²)	3,167	20	
Utah.....	2.62	426	(²)	(²)	(²)	72	(²)	(²)	(²)	
Virginia.....	.03	72	(²)	(²)	(²)	(²)	(²)	(²)	(²)	
West Virginia.....	1.85	3,306	(²)	(²)	(²)	(²)	(²)	(²)	(²)	
Undistributed.....			14,764	(²)	(²)	(²)	(²)	(²)	(²)	
Total, 1944.....	3.51	151,150	165,650	19,757	23,204	5,832	10,598	84,872	72,336	
								371,937	6,923	

¹ Yield computed by dividing production of breeze by coal charged at plants actually recovering.

² Included under "Undistributed."

³ As reported: Quantity produced but not used was undoubtedly greater. See Mineral Resources of the United States, 1922, pt. 2, pp. 726-727.

TABLE 27.—Shipments and value of reclaimed beehive coke in Pennsylvania in 1944, by months and sizes

Month	Less than 1 inch			1 inch or more			Total		
	Net tons	Value		Net tons	Value		Net tons	Value	
		Total	Average		Total	Average		Total	Average
January	51,297	\$188,122	\$3.67	27,064	\$146,852	\$5.42	78,361	\$334,674	\$4.27
February	62,322	233,965	3.75	33,142	179,733	5.42	95,464	413,698	4.33
March	65,679	233,496	3.56	34,935	187,308	5.36	100,614	420,803	4.18
April	58,480	200,817	3.56	30,228	160,305	5.30	88,708	361,122	4.16
May	97,916	342,459	3.50	45,290	237,484	5.24	143,206	579,943	4.05
June	88,394	309,683	3.50	46,205	243,724	5.27	134,599	553,377	4.11
July	37,109	130,793	3.52	19,936	104,516	5.24	57,045	235,309	4.12
August	31,119	110,092	3.54	16,596	88,080	5.31	47,717	198,172	4.15
September	24,072	80,804	3.36	11,992	62,619	5.22	36,064	143,423	3.98
October	31,737	106,464	3.35	15,882	84,320	5.31	47,619	190,784	4.01
November	19,364	66,119	3.41	13,963	73,674	5.28	33,317	139,793	4.20
December	6,659	23,061	3.46	4,178	22,439	5.37	10,837	45,490	4.20
	572,148	2,025,834	3.54	290,403	1,590,754	5.31	871,551	3,616,588	4.15

TABLE 28.—Analysis of byproduct coke in 1944, by months, in percent

Month	Volatile matter		Fixed carbon		Ash		Sulphur		Phosphorus	
	Other coke	Foundry	Other coke	Foundry	Other coke	Foundry	Other coke	Foundry	Other coke	Foundry
At merchant plants:										
January	1.14	0.97	90.41	91.02	8.45	8.01	0.66	0.60	0.018	0.022
February	1.27	1.03	90.37	90.78	8.36	8.19	.65	.60	.017	.021
March	1.16	1.01	90.38	90.86	8.46	8.13	.65	.60	.018	.022
April	1.16	1.08	90.28	90.80	8.56	8.12	.66	.61	.017	.021
May	1.18	1.06	90.27	90.74	8.65	8.20	.64	.62	.018	.023
June	1.31	1.03	89.84	90.65	8.85	8.32	.65	.61	.019	.021
July	1.26	1.02	89.91	90.46	8.83	8.52	.66	.58	.017	.023
August	1.28	.98	89.95	90.62	8.77	8.40	.69	.62	.015	.023
September	1.21	1.10	89.94	90.47	8.85	8.43	.68	.59	.015	.021
October	1.18	1.10	89.80	90.44	9.02	8.46	.67	.61	.016	.020
November	1.10	1.10	90.04	90.26	8.86	8.64	.68	.60	.013	.019
December	1.19	1.18	89.93	90.09	8.88	8.73	.67	.61	.016	.020
	1.20	1.05	90.09	90.60	8.71	8.35	.66	.61	.017	.021
At furnace plants:										
January	.97	.88	88.71	90.87	10.32	8.25	.83	.59	.017	.032
February	.97	.91	88.71	90.86	10.32	8.23	.83	.59	.018	.031
March	.97	.94	88.73	91.02	10.30	8.04	.83	.59	.017	.048
April	1.01	.89	88.55	90.94	10.44	8.17	.84	.60	.018	.032
May	1.00	.94	88.41	90.95	10.50	8.11	.83	.59	.017	.046
June	1.02	.87	88.26	90.93	10.72	8.20	.85	.59	.017	.051
July	1.02	.91	88.17	90.95	10.81	8.14	.86	.59	.017	.049
August	1.02	.87	88.14	90.58	10.84	8.55	.85	.59	.018	.050
September	.99	.85	88.13	90.76	10.88	8.39	.85	.60	.018	.050
October	.93	.84	88.31	90.77	10.76	8.39	.84	.59	.016	.048
November	.93	.91	88.34	90.71	10.73	8.38	.84	.59	.017	.050
December	.94	.90	88.35	90.98	10.71	8.12	.85	.59	.017	.050
	.98	.89	88.40	90.86	10.62	8.25	.84	.59	.017	.050
Total:										
January	1.00	.94	89.07	90.99	9.93	8.07	.79	.60	.017	.041
February	1.03	.99	89.05	90.81	9.92	8.20	.80	.60	.018	.040
March	1.01	.99	89.06	90.90	9.93	8.11	.79	.60	.017	.040
April	1.04	1.01	88.90	90.86	10.06	8.13	.80	.61	.018	.041
May	1.04	1.02	88.78	90.80	10.18	8.18	.80	.61	.017	.038
June	1.08	.96	88.59	90.73	10.33	8.29	.81	.60	.017	.039
July	1.07	.96	88.52	90.61	10.41	8.41	.82	.59	.017	.039
August	1.07	.94	88.51	90.62	10.42	8.44	.82	.61	.017	.040
September	1.03	1.02	88.50	90.66	10.47	8.42	.81	.59	.018	.040
October	.96	1.01	88.61	90.55	10.41	8.44	.81	.61	.017	.038
November	.96	1.03	88.69	90.40	10.35	8.57	.81	.60	.017	.039
December	.99	1.08	88.68	90.34	10.33	8.58	.81	.61	.017	.038
	1.03	1.00	88.75	90.68	10.22	8.32	.81	.60	.017	.039

CONSUMPTION OF COKE

Consumption of byproduct and beehive coke in the United States in 1944 totaled 72,971,401 tons, an increase of 2 percent over 1943, the previous record high. Coke used in iron blast furnaces represented 78.2 percent of the total coke consumption.

According to figures compiled by the American Iron and Steel Institute, the quantity of coke used per ton of pig iron produced in 1944 advanced 9.2 pounds over the preceding year; and for pig iron, including ferro-alloys, the gain was 6.3 pounds. This increase was no doubt due to a number of variable factors including the increased content of the coke charged into blast furnaces.

The quantity of coke consumed in other ways (in foundries, in smelting nonferrous metals, in the manufacture of producer and water gas, in other miscellaneous chemical and industrial uses, and in domestic heating) amounted to 15,899,712 tons, an increase of 8 percent over 1943. Of the tonnage consumed in other ways, 41 percent was used in domestic heating, the second-largest trade channel for byproduct coke.

TABLE 29.—Coke consumed in manufacture of pig iron and for other purposes in the United States, 1913, 1918, 1937, and 1943-44, in net tons

Year	Total production	Imports	Exports	Net change in stocks	Indicated United States consumption ¹	Consumed by iron furnaces ¹		Remainder consumed in other ways	
						Quantity	Per cent	Quantity	Per cent
1913.....	46,299,530	101,212	987,395	(²)	45,413,347	37,192,287	81.9	8,221,060	18.1
1918.....	56,478,372	30,168	1,687,824	(²)	54,820,716	45,703,594	83.4	9,117,122	16.6
1937.....	53,375,489	286,364	526,683	+863,221	51,271,929	33,571,349	65.5	17,700,580	34.5
1943.....	71,676,063	98,127	994,607	-626,949	71,406,532	56,701,419	79.4	14,705,113	20.6
1944.....	74,037,817	63,004	866,835	+262,585	72,971,401	57,071,689	78.2	15,899,712	21.8

¹ Production plus imports minus exports, plus or minus decrease or increase, respectively, of net changes in stocks.

² From Report of American Iron and Steel Institute. Figures include coke consumed in manufacture of ferro-alloys.

³ Data not available.

TABLE 30.—Coke and coking coal consumed per net ton of pig iron made in the United States, 1913, 1918, 1937, and 1942-44

Year	Coke per net ton of pig iron and ferro-alloys ¹ (pounds)	Yield of coke from coal (per cent)	Coking coal per net ton of pig iron and ferro-alloys (pounds calculated)	Year	Coke per net ton of pig iron and ferro-alloys ¹ (pounds)	Yield of coke from coal (per cent)	Coking coal per net ton of pig iron and ferro-alloys (pounds calculated)
1913.....	2,172.6	66.9	3,247.5	1942.....	1,822.8	70.0	2,604.0
1918.....	2,120.7	66.4	3,193.8	1943.....	1,834.3	70.0	2,620.4
1937.....	1,830.6	70.3	2,604.0	1944.....	1,840.6	70.3	2,618.2

¹ From Report of American Iron and Steel Institute; consumption per ton of pig iron only, excluding furnaces making ferro-alloys, was 2,172.6 pounds in 1913, 2,120.7 in 1918, 1,806.7 in 1937, 1,791.4 in 1942, 1,800.6 in 1943, and 1,809.8 in 1944.

FURNACE, FOUNDRY, DOMESTIC, AND OTHER COKE

Tables 31 and 32 show the disposal, by major uses, of byproduct and beehive coke as reported by producers.

Byproduct coke.—In 1944, iron blast furnaces received 77 percent of all byproduct coke sold or used by producers. Furnace plants

supplied 96 percent of the byproduct coke delivered to blast furnaces compared with 92 percent in 1943. This increase was due largely to the additional coking capacities completed during the year at furnace plants. Sales of coke for furnace use by merchant byproduct-coke plants decreased 51 percent from the peak in 1943 when 8 percent of all coke shipped to blast furnaces came from merchant plants. The second largest coke consuming channel is the domestic trade, supplied mainly by merchant plants. In 1944, sales of domestic byproduct coke increased 35 percent over 1943 and totaled 6,443,329 tons, of which 77 percent was furnished by merchant plants. Sales of coke for foundry use and for other industrial purposes increased slightly from the preceding year.

Beehive coke.—The pattern of beehive-coke disposal followed in general that of previous years, 83 percent of all beehive coke sold or used going to iron blast furnaces in 1944. Unlike producers of byproduct coke who use the bulk of the output from their ovens, beehive producers in 1944 used but 11 percent of their output. Because of the need in certain areas for solid fuels for domestic heating, a considerable tonnage of run-of-oven beehive coke was sold for domestic use. This resulted in an increase of 170 percent in sales of domestic beehive coke over 1943 and amounted to 274,214 tons. Beehive coke sold for foundry use decreased 29 percent from 1943, and a drop of 8 percent was recorded in the disposal for other industrial uses.

TABLE 31.—*Byproduct coke produced and sold or used by producer in the United States in 1944, by States*

[Exclusive of screenings or breeze]

State	Produced		Used by producer				Sold—	
	Net tons	Value	In blast furnaces		For other purposes ¹		Furnace ²	
			Net tons	Value	Net tons	Value	Net tons	Value
Alabama.....	5,727,612	\$32,057,495	4,704,279	\$24,022,081	21,617	\$109,888	42,260	\$309,739
California.....	339,570	(³)	327,195	(³)	70	(³)	.....	.....
Colorado.....	650,511	(³)	637,408	(³)	10,451	(³)	.....	.....
Illinois.....	3,878,764	\$4,074,422	1,784,961	15,042,590	86,385	642,957	1,107,133	(³)
Indiana.....	8,821,021	74,079,053	5,935,249	48,949,499	79,867	579,033	1,967,002	17,014,9C4
Maryland.....	2,058,233	(³)	2,035,537	(³)	932	(³)	94,012	(³)
Massachusetts.....	1,177,850	(³)	.....	.....	129,150	(³)	.....	.....
Michigan.....	3,005,424	24,848,937	1,314,599	9,554,335	131,533	968,026	122,342	(³)
Minnesota.....	894,095	7,973,653	611,547	3,985,823	10,289	59,997	.....	.....
New Jersey.....	1,022,917	(³)	.....	.....	232,991	(³)	.....	.....
New York.....	6,102,560	47,155,591	1,871,425	15,503,259	941,397	6,448,528	1,671,152	11,780,443
Ohio.....	10,338,913	70,781,105	7,933,731	53,169,803	105,204	975,803	874,550	5,945,058
Pennsylvania.....	16,976,574	101,698,149	8,576,326	56,612,117	134,354	928,783	7,013,377	34,429,042
Tennessee.....	219,503	(³)	.....	.....	.....	.....	108,357	(³)
Texas.....	184,506	(³)	136,953	(³)	96	(³)	.....	.....
Utah.....	739,432	(³)	642,518	(³)	443	(³)	2,990	(³)
West Virginia.....	2,637,591	11,546,819	1,342,206	5,112,496	860,604	3,926,490	269,301	1,327,337
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin.....	2,289,719	20,008,332	.....	.....	189,383	1,525,841	644,379	3,762,366
Undistributed.....	54,620,616	.....	.....	31,014,057	.....	2,658,817	.....	12,023,520
Total, 1944.....	67,064,795	478,844,172	37,753,934	262,966,060	2,934,769	18,824,163	13,916,855	86,572,409
Merchant plants.....	14,144,951	119,760,289	.....	.....	2,726,330	17,379,416	1,896,803	14,127,433
Furnace plants.....	52,919,844	359,083,883	37,753,934	262,966,060	208,439	1,444,747	12,020,052	72,444,976
Total, 1943.....	63,742,676	424,125,129	34,496,795	225,276,525	3,022,276	18,335,404	16,388,644	99,416,761

See footnotes at end of table.

TABLE 31.—Byproduct coke produced and sold or used by producer in the United States in 1944, by States—Continued

State	Sold—Continued							
	Foundry		Domestic		Industrial and other (including water gas) ¹		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Alabama.....	314,724	\$2,965,067	166,561	\$967,459	446,225	\$3,494,449	969,770	\$7,736,714
California.....					9,732	(²)	9,732	(²)
Colorado.....	1,073	(²)	29	(²)	6,988	(²)	8,060	(²)
Illinois.....	284,712	(²)	505,609	4,662,347	106,117	856,988	2,003,571	18,375,842
Indiana.....	355,415	4,074,878	300,704	1,998,515	101,180	778,567	2,724,301	23,866,864
Maryland.....								
Massachusetts.....	56,103	(²)	825,492	(²)	75,210	(²)	1,050,817	(²)
Michigan.....	342,709	(²)	724,547	6,130,763	361,528	3,041,927	1,541,126	14,171,544
Minnesota.....	9,894	(²)	316,460	3,322,507	34,882	(²)	361,236	3,803,001
New Jersey.....	43,700	(²)	368,366	(²)	378,236	(²)	790,302	(²)
New York.....			1,202,666	10,127,321	363,420	2,894,824	3,237,238	24,782,588
Ohio.....	243,648	2,335,839	388,208	2,658,903	811,588	5,839,937	2,317,994	16,779,737
Pennsylvania.....	214,794	2,418,283	725,882	4,881,307	275,702	2,137,656	8,229,755	43,866,288
Tennessee.....	46,068	(²)	2,588	(²)	60,666	(²)	217,679	(²)
Texas.....	3,606	(²)	6,118	(²)	8,070	(²)	17,794	(²)
Utah.....			1,707	(²)	60,308	(²)	65,005	(²)
West Virginia.....	67,859	658,398	26,315	124,197	82,309	434,532	445,784	2,544,464
Connecticut, Kentucky, and Missouri.....								
Wisconsin.....	246,230	2,948,133	882,077	8,745,762	268,550	2,446,600	2,041,236	17,902,861
Undistributed.....		9,207,703		11,956,172		5,477,076		20,328,616
Total, 1944.....	2,230,535	24,608,301	6,443,329	55,575,253	3,440,711	27,402,556	26,031,430	194,158,519
Merchant plants.....	1,692,357	18,872,515	4,930,165	45,573,135	2,719,025	22,181,007	11,238,350	100,754,090
Furnace plants.....	538,178	5,735,786	1,513,164	10,002,118	721,686	5,221,549	14,793,080	93,404,429
Total, 1943.....	2,217,499	22,557,740	4,784,090	39,292,885	3,340,797	24,087,960	26,731,230	185,355,356

¹ Comprised of 46,871 tons valued at \$341,426 used in foundries; 830,790 tons, \$5,678,925 used to make producer gas; 882,211 tons, \$6,420,591 used to make water gas; and 1,174,897 tons, \$6,363,221 used for other purposes than in blast furnaces.

² Includes 11,747,486 tons valued at \$70,099,354 sold to financially affiliated corporations for blast furnace use.

³ Included under "Undistributed."

⁴ Includes 3,273 tons valued at \$18,925 for foundry use; 339,514 tons, \$2,463,389 for manufacture of water gas; and 289,693 tons, \$2,124,612 for other industrial use sold to financially affiliated corporations and 1,096,228 tons, \$8,955,910 for manufacture of water gas sold to other consumers.

TABLE 32.—Beehive coke produced and sold or used by producer in the United States in 1944, by States

State	Produced		Used by producer				Sold—	
			In blast furnaces		For other purposes		Furnace ¹	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Colorado.....	81,684	(²)			81,206	(²)		
Kentucky.....	68,076	(²)					34,503	(²)
Pennsylvania.....	6,170,897	\$42,956,659	667,647	\$4,817,316	7,510	\$45,799	4,749,161	\$32,551,268
Tennessee.....	8,850	(²)	3,731	(²)			4,984	(²)
Utah.....	21,442	(²)	12,677	(²)			3,568	(²)
Virginia.....	243,116	1,895,243					103,371	794,215
West Virginia.....	378,957	2,708,821			84	(²)	240,922	1,628,406
Undistributed.....		1,516,611		139,787		772,005		315,306
Total: 1944.....	6,973,022	49,077,334	674,055	4,957,103	88,800	817,804	5,136,509	35,289,195
1943.....	7,933,387	51,992,343	555,486	3,677,616	89,553	743,785	6,249,035	40,316,281

See footnotes at end of table.

TABLE 32.—*Beehive coke produced and sold or used by producer in the United States in 1944, by States—Continued*

State	Sold—Continued							
	Foundry		Domestic		Industrial and other (including water gas) ¹		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Colorado.....	142	(²)	-----	-----	220	(²)	362	(²)
Kentucky.....	-----	-----	-----	-----	33,573	(²)	68,076	(²)
Pennsylvania.....	166,906	\$1,370,515	253,096	\$1,765,821	330,794	\$2,356,393	5,496,959	\$38,043,997
Tennessee.....	-----	-----	-----	-----	-----	-----	4,984	(²)
Utah.....	329	(²)	-----	-----	4,826	(²)	8,723	(²)
Virginia.....	28,284	240,392	3,001	19,093	109,050	845,700	243,706	1,999,400
West Virginia.....	35,512	320,637	18,117	126,761	85,463	641,096	380,014	2,715,890
Undistributed.....	-----	4,512	-----	-----	-----	282,779	-----	602,597
Total: 1944....	231,175	1,936,046	274,214	1,910,675	563,926	4,126,968	6,206,824	43,261,684
1943....	326,589	2,505,231	101,438	621,842	610,059	4,126,628	7,287,121	47,568,982

¹ Includes 1,899,943 tons valued at \$12,474,267 sold to financially affiliated corporations for blast furnace use.

² Included under "Undistributed."

³ Includes 387 tons valued at \$2,531 sold to financially affiliated corporations for other industrial use and 170,551 tons, \$1,244,596, for manufacture of water gas.

STOCKS OF COKE AND COKING COAL

Producers' stocks of byproduct coke increased 32 percent during 1944 and at the end of the year totaled 1,086,446 tons. Table 33 gives details of the total quantity of coke and breeze on hand at all coke plants, by States, on January 1, 1945. Stocks of byproduct furnace and foundry coke decreased slightly, whereas stocks of domestic coke increased 106 percent over 1943. The increase in stocks of domestic coke was due largely to Government limitations on deliveries during the fuel year 1944-45 and to adverse weather conditions that hampered transportation in December. Table 35 shows the stocks of coke on hand at producers' plants, by months, during 1943 and 1944.

Because of lack of available storage facilities and loading equipment at beehive-coke plants, stocks of coke on hand are usually very small. Producers' stocks of beehive coke varied only slightly from those of the preceding year and on January 1, 1945, totaled 38,239 tons.

TABLE 33.—*Stocks of furnace, foundry, and domestic coke and of breeze in the United States on January 1, 1945, by States, in net tons*

State	Coke				Breeze
	Furnace	Foundry	Domestic and other	Total	
Byproduct:					
Alabama.....	74,802	1,317	3,134	79,253	9,601
California.....	29,145			29,145	37,841
Colorado.....	1,398			1,398	9,099
Illinois.....	37,810	536	23,550	61,896	129,480
Indiana.....	15,484	1,113	75,421	92,018	225,560
Maryland.....	43,479			43,479	209,078
Massachusetts.....	74	185	94,827	95,086	24,616
Michigan.....	3,380	938	9,647	13,965	37,687
Minnesota.....	329	474	19,085	19,888	38,975
New Jersey.....			8,948	8,948	7,937
New York.....	42,494	10	168,973	211,477	106,243
Ohio.....	57,536	9,208	7,425	74,469	90,453
Pennsylvania.....	120,282	960	40,453	161,695	439,711
Tennessee.....	7,449	142		7,591	7,362
Texas.....	16,336	2,500	5,000	23,836	1,000
Utah.....	9,033		25,443	34,476	71,960
West Virginia.....	17,032	403	11,126	28,561	19,228
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin.....	1,770	479	97,016	99,265	25,953
	478,133	18,265	590,048	1,086,446	1,491,784
At merchant plants.....	25,614	13,286	458,022	496,922	192,439
At furnace plants.....	452,519	4,979	132,026	589,524	1,299,345
Beehive:					
Colorado.....			245	245	
Pennsylvania.....	31,454	80	3,521	35,055	
Tennessee.....	135			135	
Utah.....		222		222	
Virginia.....	521	135	27	683	
West Virginia.....	1,639	329	31	1,999	
	33,649	766	3,824	38,239	

TABLE 34.—*Summary of total stocks of coke on hand at all byproduct and beehive plants in the United States on January 1, 1937, and 1941-45, in net tons*

[Exclusive of screenings or breeze]

	1937	1941	1942	1943	1944	1945
Byproduct plants:						
Furnace.....	282,144	525,798	697,898	770,135	517,452	478,133
Foundry.....	8,981	14,123	20,448	21,937	21,490	18,265
Domestic and other.....	1,406,350	1,373,213	991,045	661,401	286,671	590,048
	1,690,475	1,913,134	1,709,391	1,453,473	825,613	1,086,446
Beehive plants:						
Furnace.....	5,622	16,022	20,311	24,617	30,740	33,649
Foundry.....	8,508	3,973	4,967	2,203	482	766
Domestic and other.....	18,461	23,313	23,397	8,756	5,265	3,824
	32,591	43,308	48,695	35,576	36,487	38,239
Total:						
Furnace.....	287,766	541,820	718,209	794,752	548,192	511,782
Foundry.....	17,489	18,096	25,435	24,140	21,972	19,031
Domestic and other.....	1,426,811	1,396,526	1,014,442	670,157	291,936	593,872
	1,732,066	1,956,442	1,758,086	1,489,049	862,100	1,124,685

TABLE 35.—Total stocks of coke at all furnace and nonfurnace byproduct plants in the United States on first of each month, 1943-44, in net tons

[Includes furnace, foundry, and domestic, but not breeze]

Month	Furnace plants		Other plants		Total	
	1943	1944	1943	1944	1943	1944
January.....	825,375	528,511	628,098	297,102	1,453,473	825,613
February.....	816,300	640,846	453,141	208,493	1,269,441	849,339
March.....	756,877	561,021	312,101	151,659	1,068,978	712,680
April.....	635,921	513,404	229,968	108,582	865,919	621,986
May.....	742,800	535,244	210,199	149,454	952,999	684,698
June.....	719,847	569,441	228,992	186,439	948,839	755,880
July.....	601,590	553,789	240,671	230,688	842,531	784,477
August.....	569,551	589,067	206,702	331,765	896,253	920,832
September.....	650,412	596,014	366,039	389,616	1,016,451	985,629
October.....	691,259	565,118	404,134	430,134	1,095,393	995,252
November.....	709,272	585,899	417,870	454,097	1,127,142	1,039,996
December.....	605,379	688,327	379,563	509,229	984,942	1,197,556

Table 36 shows the stocks of bituminous coal at byproduct-coke plants, by months, for 1937 and 1942-44. In 1944 coal stocks remained rather constant throughout the year and on December 31 were equivalent to an average 24 days' supply compared with 25 days at the end of 1943. Stocks of coal were lowered by mine stoppages in 1943 and could not be built up during 1944 to a 30-day supply, which is considered the minimum required in wartime. A number of plants averaged less than a week's supply at certain times during the year, and the Solid Fuels Administration for War diverted thousands of tons of coal from byproduct-coke plants having more than a 30-day supply and from other industrial plants that were using coking coal for steam generation to plants with inadequate reserves. A summary of the regulation issued by Solid Fuels Administration for War covering byproduct coal is given under Government Control Measures in this report.

TABLE 36.—Stocks of bituminous coal at byproduct coke plants in the United States at the end of each month, 1937 and 1942-44

Month	1937	1942	1943	1944
January.....	8,030,871	8,178,962	9,952,627	6,137,165
February.....	8,687,389	7,888,481	9,778,403	6,382,553
March.....	9,038,317	7,881,459	9,850,617	6,280,880
April.....	8,543,774	8,408,907	9,732,267	5,929,623
May.....	8,187,883	9,179,025	9,219,153	5,891,893
June.....	7,770,266	9,866,281	7,142,587	6,127,041
July.....	7,432,741	9,922,306	6,818,746	5,708,408
August.....	7,455,932	10,238,114	6,811,435	5,927,586
September.....	7,760,533	10,565,801	6,590,622	6,173,834
October.....	8,066,938	10,997,933	6,657,479	6,396,922
November.....	8,114,094	11,150,840	5,819,664	6,737,442
December.....	7,273,403	10,721,414	6,305,514	6,111,538

VALUE AND PRICE

The term "value" as used in this report means the value of coke at ovens. The greatest part of the coke produced in the United States is made in ovens operated by corporations, which not only mine the coal they use but also operate blast furnaces that consume the bulk of the output of their ovens. Under such conditions, fixing a value for coal charged and for coke produced is purely arbitrary. For example, at some establishments the cost of coke to the furnace department equals the cost of production; with others a margin of profit is added, or the cost is considered to be the market value.

The total value of all coke produced, by States, is shown in table 10 and was 11 percent higher than in 1943. Pennsylvania led all States in value and tonnage produced, accounting for almost one-third of the total value of the byproduct- and beehive-coke output.

The average receipts per ton of coke sold in 1944 increased sharply over those of the preceding year because of higher coal and labor costs. Receipts per ton of byproduct coke sold in 1944 increased over 1943 as follows: Furnace, \$0.18; foundry, \$0.86; domestic, \$0.42; and other industrial, \$0.69.

Average sales realization for beehive coke showed the following price increases per ton over 1943: \$0.42 for furnace, \$0.70 for foundry, \$0.84 for domestic, and \$0.56 for other industrial.

TABLE 37.—Average receipts per net ton for coke sold in the United States in 1944, by States

State	Byproduct ¹				Beehive ¹			
	Fur-nace	Found-ry	Do-mestic	Other indus-trial including wa-ter gas	Fur-nace	Found-ry	Do-mestic	Other indus-trial including wa-ter gas
Alabama.....	\$7.33	\$9.42	\$5.81	\$7.83				
California.....		(²)	(²)	(²)				
Colorado.....	(²)	(²)	9.22	8.08		(²)		(²)
Illinois.....	8.65	11.47	6.66	7.69				
Indiana.....		(²)	(²)	(²)				
Maryland.....	(²)	(²)	(²)	(²)				
Massachusetts.....	(²)	(²)	8.46	8.66				
Michigan.....	(²)	(²)	10.50	(²)				
Minnesota.....		(²)	(²)	(²)				
New Jersey.....		(²)	(²)	(²)				
New York.....	7.04		8.42	7.97				
Ohio.....	6.80	9.59	6.85	7.20				
Pennsylvania.....	4.91	11.26	6.72	7.75	\$6.85	\$8.21	\$6.98	\$7.12
Tennessee.....	(²)	(²)	(²)	(²)				
Texas.....	(²)	(²)	(²)	(²)				
Utah.....	(²)		(²)	(²)	(²)	(²)		(²)
Virginia.....					7.68	8.50	6.36	7.76
West Virginia.....	4.93	9.70	4.72	8.28	6.76	9.03	6.94	7.50
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin.....	5.84	11.97	9.91	9.11	(²)			(²)
Undistributed.....	8.38	11.69	9.93	8.64	7.32	9.58		7.32
United States average.....	6.27	11.03	8.63	8.12	6.87	8.37	6.97	7.32
At merchant plants.....	7.45	11.15	9.24	8.16				
At furnace plants.....	6.03	10.66	6.61	7.24				

¹ Includes coke sold to affiliated corporations for all purposes and merchant sales.

² Included under "Undistributed."

SHIPMENTS BY RAIL, WATER, AND TRUCK

Table 39 shows the quantity of byproduct and beehive coke shipped from producing plants by rail, water, and truck.

A large part of the byproduct coke produced is consumed by the producer in adjacent steel works and therefore is not loaded for shipment outside the plant. Total shipments of byproduct coke in 1944 amounted to 26,031,430 tons, or 39 percent of the total output. Railroads transported 85 percent of the total byproduct-coke shipments compared with 84 percent in 1943. In spite of tire and gasoline rationing, the percentage moved by truck increased 1 percent over 1943. Shipments by boat are relatively insignificant in the movement of coke, and in 1944 the quantity so moved decreased 2 percent below 1943.

The bulk of beehive coke produced near the mines is loaded at the plants for shipment to centers of consumption, and in 1944, 89 percent of the total output was transported from producing plants. Railroads transported 98 percent of all beehive shipments in 1944; truck and boat, 2 percent.

TABLE 38.—Beehive coke loaded for shipment on originating railroads, waterways, and trucks in the United States in 1944, by routes, as reported by producers

Route	State	Net tons		Percent of total
		By States	Total	
Railroads:				
Baltimore & Ohio.....	(Pennsylvania.....	1,449,403	1,667,938	26.9
	West Virginia.....	218,535		
Chesapeake & Ohio.....	Kentucky.....	68,076	108,414	1.7
	West Virginia.....	40,338		
Denver & Rio Grande Western.....	Colorado.....	362	7,056	.1
	Utah.....	6,694		
Interstate.....	Virginia.....	207,796	207,796	3.3
Ligonier Valley.....	Pennsylvania.....	70,358	70,358	1.1
Louisville & Nashville.....	Virginia.....	5,663	5,663	.1
Monongahela.....	Pennsylvania.....	1,291,886	1,291,886	20.8
Nashville, Chattanooga & St. Louis.....	Tennessee.....	4,984	4,984	.1
New York Central.....	West Virginia.....	111,736	111,736	1.8
Norfolk & Western.....	Virginia.....	30,053	30,053	.5
Pennsylvania.....	Pennsylvania.....	2,482,549	2,482,549	40.0
Pittsburgh & Lake Erie.....	do.....	56,277	56,277	.9
Western Maryland.....	West Virginia.....	9,385	9,385	.2
Total railroad shipments.....		6,054,095	6,054,095	97.5
Waterways: Monongahela & Ohio Rivers.....	Pennsylvania.....	129,495	129,495	2.1
Trucks.....	(¹).....	22,234	22,234	.4
Grand total.....		6,205,824	6,205,824	100.0

¹ Pennsylvania, Utah, Virginia, and West Virginia.

TABLE 39.—Sales of coke and breeze that was loaded at plants in the United States for shipment in 1944, by States, in net tons

State	Coke				Breeze			
	In rail-road cars	In boats	In trucks	Total	In rail-road cars	In boats	In trucks	Total
Byproduct:								
Alabama.....	930, 903		38, 867	969, 770	122, 570			122, 570
California.....	9, 732			9, 732	8, 625			8, 625
Colorado.....	7, 957		133	8, 090	15, 872		434	16, 306
Illinois.....	1, 965, 695		47, 876	2, 003, 571	100, 588		63	100, 651
Indiana.....	2, 653, 180		71, 121	2, 724, 301	127, 936		4, 304	132, 240
Maryland.....					37, 255	40, 193		77, 448
Massachusetts.....	599, 186	16, 284	435, 347	1, 050, 817			2, 945	2, 945
Michigan.....	1, 170, 818	182, 165	188, 143	1, 541, 126	39, 905	4, 071	79	44, 055
Minnesota.....	317, 108		44, 128	361, 236	31, 756		2	31, 758
New Jersey.....	359, 346	177, 264	256, 692	793, 302	151		170	321
New York.....	2, 306, 583	181, 114	750, 541	3, 237, 238	47, 247		1, 650	48, 906
Ohio.....	2, 039, 077	133, 660	145, 257	2, 317, 994	138, 660	8, 345	2, 815	149, 820
Pennsylvania.....	7, 389, 237	640, 726	199, 792	8, 229, 755	126, 168	32, 228	4, 057	162, 453
Tennessee.....	217, 679			217, 679	5, 686			5, 686
Texas.....	17, 794			17, 794	3, 487			3, 487
Utah.....	60, 214		4, 791	65, 005	46, 097			46, 113
West Virginia.....	439, 952		5, 832	445, 784	17, 277		16	17, 277
Connecticut, Kentucky, Missouri, Rhode Is- land, and Wisconsin.....	1, 626, 003	54, 618	358, 615	2, 041, 236	24, 983	7, 702	11, 801	44, 486
	22, 096, 464	1, 387, 831	2, 547, 135	26, 031, 430	897, 263	92, 539	28, 345	1, 018, 147
At merchant plants.....	8, 554, 241	498, 643	2, 185, 466	11, 238, 350	155, 058	20, 090	22, 494	197, 642
At furnace plants.....	13, 542, 223	889, 188	361, 669	14, 793, 080	742, 205	72, 449	5, 851	820, 505
Beehive:								
Colorado.....	362			362				
Kentucky.....	68, 076			68, 076				
Pennsylvania.....	5, 350, 473	129, 495	19, 991	5, 499, 959	81, 276		429	81, 705
Tennessee.....	4, 984			4, 984				
Utah.....	6, 694		2, 029	8, 723	3, 167			3, 167
Virginia.....	243, 512		194	243, 706				
West Virginia.....	379, 994		20	380, 014				
	6, 064, 095	129, 495	22, 234	6, 205, 824	84, 443		429	84, 872

DISTRIBUTION OF BYPRODUCT AND BEEHIVE COKE

For practical purposes the terms "distribution" and "consumption" are used herein interchangeably. The total quantity of byproduct and beehive coke available for consumption in the United States, excluding imports, in 1944 increased 2 percent over 1943 and amounted to 73,035,439 tons. Deliveries to blast furnaces and export shipments for furnace use declined slightly from 1943. Shipments of coke to consumers for foundry use both in the United States and foreign destinations declined 93,796 tons from the preceding year. Shipments of coke for manufacturing water gas declined 27 percent from 1943; the decline is due to a change in the 1944 classification of coke consumed in the manufacture of water gas which is used in chemical synthesis from "water gas" to "other industrial". If this tonnage were added, the 1944 water-gas figure would be 6 percent higher than for the preceding year. Coke available for domestic heating within the United States increased 35 percent and export shipments 127 percent.

TABLE 40.—Summary of byproduct and beehive coke and breeze consumed in each State in 1944, in net tons

[Based upon reports from all United States producers showing destination of coke used by producer or sold in 1944. Does not include imported coke which totaled 63,004 tons in 1944]

Consuming State	Coke						Coke breeze
	Furnace use	Foundry use	Making producer gas	Making water gas	Other industrial use	Domestic use	
Alabama.....	4,746,477	115,145	-----	1,013	212,844	91,584	5,167,063
Arizona.....	-----	4,613	-----	-----	1,138	-----	5,751
Arkansas.....	-----	524	-----	491	183	36	1,234
California.....	328,824	58,075	-----	-----	36,770	-----	423,669
Colorado.....	637,408	14,477	-----	-----	23,944	29	675,858
Connecticut.....	-----	36,963	86,260	101,484	9,754	196,277	430,738
Delaware.....	-----	4,950	-----	-----	891	6,789	12,630
District of Columbia.....	-----	255	-----	50,522	16,456	1,532	68,765
Florida.....	-----	1,580	-----	41,321	5,632	4,262	62,795
Georgia.....	-----	15,725	-----	12,627	14,578	12,150	55,080
Idaho.....	-----	738	-----	-----	4,548	-----	5,286
Illinois.....	4,850,900	255,212	31,254	54,629	103,162	545,157	5,840,314
Indiana.....	5,950,680	127,487	-----	37,528	144,721	246,345	6,506,761
Iowa.....	-----	48,888	-----	2,127	30,939	9,352	91,306
Kansas.....	-----	11,153	-----	-----	1,693	-----	12,846
Kentucky.....	634,441	15,700	-----	101,875	28,900	54,462	835,378
Louisiana.....	-----	3,560	-----	-----	46,325	4,339	54,224
Maine.....	-----	3,955	-----	3,480	534	60,904	68,873
Maryland.....	2,434,748	22,847	-----	29,232	26,773	3,886	2,517,486
Massachusetts.....	111,214	50,640	119,291	115,485	10,862	854,704	1,262,196
Michigan.....	1,331,497	316,060	7,714	2,846	339,503	750,877	2,748,497
Minnesota.....	511,547	32,800	5,407	5,628	30,769	305,264	891,415
Mississippi.....	-----	1,109	-----	-----	1,054	1,069	3,232
Missouri.....	-----	75,047	-----	968	42,092	96,166	214,273
Montana.....	-----	2,538	-----	-----	30,285	-----	32,823
Nebraska.....	-----	3,021	-----	11,707	1,200	509	16,437
Nevada.....	-----	68	-----	-----	9,411	-----	9,479
New Hampshire.....	-----	4,656	-----	2,281	1,124	71,128	79,189
New Jersey.....	-----	80,467	94,796	306,705	128,353	464,150	1,074,511
New Mexico.....	-----	287	-----	-----	947	-----	1,234
New York.....	3,699,670	144,027	317,137	785,265	330,073	1,232,028	6,508,200
North Carolina.....	-----	9,108	-----	4,222	5,295	3,416	22,041
North Dakota.....	-----	187	-----	315	544	1,276	2,322
Ohio.....	12,491,620	284,499	-----	184,145	249,985	315,201	13,525,450
Oklahoma.....	-----	3,483	-----	-----	184	-----	3,667
Oregon.....	-----	6,667	-----	-----	7,891	-----	14,558
Pennsylvania.....	17,487,995	296,490	77,655	167,745	291,759	385,734	18,707,378
Rhode Island.....	-----	8,485	34,147	4,843	1,549	146,102	195,126
South Carolina.....	-----	4,163	-----	2,230	6,169	4,880	17,442
South Dakota.....	-----	191	-----	-----	156	1,366	1,713
Tennessee.....	138,707	83,526	-----	51,544	39,871	9,982	323,630
Texas.....	136,953	24,337	-----	65	56,255	6,118	223,728
Utah.....	660,124	10,118	-----	-----	44,415	1,707	716,364
Vermont.....	-----	4,226	-----	1,875	2,957	22,881	31,939
Virginia.....	75,997	41,843	-----	342,671	79,064	2,975	542,550
Washington.....	-----	9,035	-----	-----	2,292	-----	11,327
West Virginia.....	1,234,689	32,371	1,665	36,683	1,066,869	1,614	2,313,921
Wisconsin.....	-----	136,471	65,467	24,950	37,176	414,906	678,970
Wyoming.....	-----	-----	-----	-----	1	-----	1
Exported.....	57,463,491	2,407,767	840,793	2,488,502	3,467,920	9,331,197	72,999,670
	17,862	104,253	-----	-----	180,681	386,346	689,142
	57,481,353	2,512,020	840,793	2,488,502	3,648,601	9,717,543	73,688,812
	-----	-----	-----	-----	-----	-----	5,211,708

EXPORTS AND IMPORTS

Shipments of coke to foreign countries in 1944 represented only 1 percent of the total output and amounted to 866,835 net tons, valued at \$7,334,309. This was a decrease of 13 percent in quantity, but because of the higher prices prevailing the decrease in value was only \$8,179. Over 94 percent of the total export shipments were destined to Canada, for the most part moving through the Buffalo and Michigan customs districts.

* Figures on exports and imports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Imports of coke supply an insignificant part of the Nation's requirements and are restricted to a few localities. The total tonnage imported in 1944 amounted to 63,004 tons, a decrease of 36 percent from 1943. Canada supplied all of the coke imported, the bulk of which entered through the Buffalo, Montana, and Idaho districts.

TABLE 41.—Coke exported from the United States, 1942-44, by countries and customs districts

	1942		1943		1944	
	Net tons	Value	Net tons	Value	Net tons	Value
COUNTRY						
North America:						
Canada.....	806,517	\$5,925,858	962,489	\$6,865,179	820,434	\$6,604,080
Mexico.....	2,032	23,497	6,466	52,426	6,813	68,272
Panama.....	111	2,403	6	74	3	45
West Indies:						
Cuba.....	11,760	123,516	2,893	37,916	15,724	226,577
Trinidad and Tobago.....			73	859	1,070	17,335
Other North America.....	475	9,298	769	22,618	1,243	28,426
South America:						
Argentina.....	5,048	79,087	4,988	88,861	1,765	22,883
Bolivia.....	200	3,349	296	7,291	284	6,657
Brazil.....	4,742	81,314	9,714	148,575	6,760	106,583
Chile.....	7,417	75,719	5,090	80,320	10,720	216,768
Peru.....	398	10,337	903	19,928	333	6,011
Other South America.....	661	10,474	670	14,691	563	13,029
Europe:						
Azores.....			250	3,750		
Spain.....					986	13,977
Africa.....	221	4,949			137	3,666
	839,582	6,349,801	994,607	7,342,488	866,835	7,334,309
CUSTOMS DISTRICT						
Buffalo.....	280,085	1,995,909	500,418	3,328,111	420,203	2,950,673
Chicago.....	6,395	18,558			5,843	45,494
Dakota.....	18,472	158,673	27,722	223,400	16,045	156,320
Duluth and Superior.....	9,296	86,835	11,221	90,127	7,776	80,109
Florida.....	4,487	56,119	5,551	78,268	17,455	251,799
Laredo.....	1,335	13,962	1,014	9,093	1,796	18,447
Maryland.....	2,926	27,134	2,285	27,875	4,454	57,674
Michigan.....	417,608	3,300,445	324,258	2,600,182	311,003	2,880,247
Mobile.....	7,135	66,957	3,733	34,131	668	8,038
New Orleans.....	3,937	59,880	9,351	173,754	10,359	199,104
New York.....	5,704	111,585	3,876	90,537	4,321	111,633
Ohio.....	70,819	331,769	52,258	229,051	24,200	184,702
Philadelphia.....			459	9,891	986	13,977
St. Lawrence.....	3,506	30,977	15,840	116,419	29,497	250,425
San Diego.....	503	7,176	546	6,052	520	7,065
San Francisco.....	6	167	189	6,525	64	2,537
Virginia.....	6,767	75,164	195	2,494	1,476	22,060
Other districts.....	601	8,491	35,691	316,578	10,170	94,005
	839,582	6,349,801	994,607	7,342,488	866,835	7,334,309

TABLE 42.—Coke imported for consumption in the United States, 1942-44, by countries and customs districts

	1942		1943		1944	
	Net tons	Value	Net tons	Value	Net tons	Value
COUNTRY						
Canada.....	97,709	\$1,223,170	97,654	\$1,107,499	63,004	\$730,650
Mexico.....	7,291	84,579				
United Kingdom ¹	3,819	34,449	473	5,364		
	108,819	1,342,198	98,127	1,112,863	63,004	730,650
CUSTOMS DISTRICT						
Buffalo.....	51,732	972,013	51,562	838,224	23,181	421,160
El Paso.....	6,674	79,919				
Florida.....			473	5,364		
Laredo.....	617	4,660				
Maine and New Hampshire.....	85	713	534	4,837	293	2,768
Montana and Idaho.....	38,877	218,241	31,798	192,626	38,345	298,653
New York.....	3,819	34,449				
St. Lawrence.....			37	498	17	181
Vermont.....			573	7,498	98	983
Washington.....	7,015	32,203	13,160	63,816	1,070	6,905
	108,819	1,342,198	98,127	1,112,863	63,004	730,650

¹ United Kingdom of Great Britain and Northern Ireland.**WORLD PRODUCTION**

Data on world production of coke are not complete, but information obtained from various Government sources indicates that output in most of the major producing countries increased over 1943. In Canada, coke production continued the upward trend that started in 1939 and was 19 percent higher in 1944 than the previous peak established in 1943. In spite of heavy bombing of the Ruhr area of Germany, commencing in the summer of 1942 and continuing through 1944, estimated coke production for the 1943-44 coal year increased 639,000 metric tons over the preceding coal year. Of the total production shown in table 43 for Germany, including the Saar, in 1944, it is estimated that more than 66 percent was produced in the Ruhr. Data on 1944 production in Great Britain are not available; however, production in 1943 showed a decrease of 3 percent from the preceding year. Production in Free China is shown for the first time, and a decrease from 1943 is noted in the 1944 output. Production in Spain increased slightly over 1943 but fell short 3,222 tons of the peak established in 1940.

COKE AND BYPRODUCTS

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[Compiled by R. B. Waldbauer]

Country †	1929	1938	1940	1941	1942	1943	1944
Australia:							
New South Wales	471,913	1,153,470	1,292,484	1,738,864	1,644,897	1,592,325	(1)
Queensland	4,144	31,491	(1)	(1)	(1)	(1)	(1)
Belgium	6,192,900	4,894,980	3,948,000	(1)	4,470,000	4,421,000	(1)
Brazil			9,912	21,068	10,267	19,846	(1)
Bulgaria		3,923	6,000	(1)	(1)	(1)	(1)
Canada	1,960,322	1,806,888	2,321,773	2,311,942	2,536,155	2,709,354	3,217,107
China	113,467	111,630	16,466	(1)	(1)	(1)	420,026
Czechoslovakia	3,170,639	2,867,000	(1)	(1)	(1)	(1)	(1)
France	39,421,033	7,785,000	5,255,000	48,136,000	48,048,000	49,457,000	49,896,000
Germany ‡	2,423,000	43,611,062	{ 4,237,000	{ 2,186,000	{ 3,207,000	{ 3,304,000	{ 3,834,000
East	13,057,000	13,031,394	15,497,384	14,780,479	15,791,146	14,893,866	(1)
West	2,423,000	83,092	(1)	(1)	(1)	(1)	(1)
Hungary	843,324	1,738,178	(1)	1,996,436	1,862,533	(1)	(1)
India, British ‡	791,697	1,739,417	2,608	(1)	(1)	(1)	(1)
Indonesia	498,777	3,503	(1)	(1)	(1)	(1)	(1)
Italy	2,402,566	3,158,065	(1)	(1)	(1)	(1)	(1)
Netherlands		49,875	(1)	(1)	(1)	(1)	(1)
New Caledonia			89,762	99,700	83,661	(1)	(1)
Norway	35,892	2,523,260	(1)	(1)	(1)	(1)	(1)
Poland	1,938,052	47,866	13,60,238	13,68,556	13,75,765	13,68,558	13,76,883
Rhodesia, Southern	100,001	84,030	(1)	(1)	(1)	(1)	(1)
Russia		871,489	839,744	753,108	814,555	801,122	836,922
Spain	768,040	112,107	100,753	(1)	(1)	(1)	(1)
Sweden	103,778	84,930	60,192	58,642	81,960	90,000	(1)
Turkey		163,315	(1)	(1)	(1)	(1)	(1)
Union of South Africa	99,297	20,700,000	16,500,000	(1)	(1)	(1)	(1)
U. S. S. R.	4,700,000	20,479,553	51,774,669	59,135,960	64,018,735	65,023,091	67,165,627
United States	54,325,427						
	142,926,000	135,110,000	(1)	(1)	(1)	(1)	(1)

† Gas-house coke not included.

‡ In addition to countries listed coke is produced in Chosen and Japan, but data of production are not available.

§ Data not available.

¶ Coal year ended March 31 of year stated.

** Exports.

†† January to August, inclusive.

‡‡ Production of Free China.

§§ Excluding Sweden since October.

|| Excluding October 1939 East Upper Silesian production included.

¶¶ In Great Britain production of gas-house coke (including breeze), not included, is especially important and was 13,049,139 tons in 1938.

*** Figures for 1929 represent "hard" and "soft" coke made at collieries only—73,616 tons of "hard" coke and 799,888 tons of "soft" coke. Data for other years represent total "hard"

coke manufactured. In addition, "soft" coke made at collieries was as follows: 1938, 921,479 tons; 1941, 281,071; 1942, 246,648 tons.

§§ Sales of coke by Wankie Colliery for year ended August 30 of year stated.

|| Exclusive of Mexico.

MEDIUM- AND LOW-TEMPERATURE COKE

Salient statistics on coke and byproducts obtained by the carbonization of bituminous coal at medium- and low-temperature plants are shown in table 44. Although this process of treating coal is fundamentally the same as in high-temperature byproduct-coke ovens, the design and operating features of medium- and low-temperature ovens are radically different, and the resultant coke and byproducts produced differ in chemical and physical properties; for this reason, the Bureau of Mines has established a separate classification for this group of plants. Because only two companies operated before 1943, data for these plants were included with those for byproduct plants.

TABLE 44.—*Salient statistics of medium- and low-temperature carbonization plants in the United States in 1944*

Coke produced:		
Quantity.....	net tons..	223,691
Value.....		\$1,578,713
Screenings or breeze produced:		
Quantity.....	net tons..	40,377
Value.....		\$109,886
Coal charged into ovens:		
Quantity.....	net tons..	363,564
Value.....		\$1,103,223
Average per ton.....		\$3.03
Average yield in percent of coal charged:		
Coke.....		61.53
Breeze.....		14.51
Ovens:		
In existence December 31.....		66
Annual capacity of ovens December 31.....	net tons..	276,400
Disposal of coke:		
Sold to other consumers—		
For other industrial use:		
Quantity.....	do.....	19,739
Value.....		\$171,636
For domestic use:		
Quantity.....	net tons..	189,009
Value.....		\$1,329,861
Disposal of screenings or breeze:		
Sold:		
Quantity.....	net tons..	18,731
Value.....		\$46,505
Average receipts per ton sold:		
Other industrial coke.....		\$8.71
Domestic coke.....		\$7.04
Screenings or breeze.....		\$2.48
Stocks on January 1, 1945:		
Domestic and other.....	net tons..	15,266
Screenings or breeze.....	do.....	27,024
Byproducts produced:		
Tar.....	gallons..	3,893,646
Gas.....	M cubic feet..	1,963,217
Burned in coking process.....	percent..	53.08
Surplus sold or used.....	do.....	28.18
Wasted.....	do.....	18.74
Yield of byproducts per ton of coal:		
Tar.....	gallons..	10.71
Gas.....	M cubic feet..	7.06
Value of byproducts sold:		
Tar (sold and used).....		¹ \$355,009
Gas (surplus).....		\$111,303
Total value of coke and breeze produced and byproducts sold.....		\$2,154,911

¹ Includes value of other byproducts of tar distillation at 1 plant.

Production of medium- and low-temperature coke in 1944 amounted to 223,691 tons. The average yield of coke per ton of coal carbonized was 61.53 percent compared with 71.01 percent for high-temperature byproduct ovens; however, the percentage of breeze recovered was higher, averaging 14.51 percent compared with 5.29 percent for the byproduct industry. This coke is not generally used for metallurgical

purposes, and as it is an excellent fuel for household heating 84 percent of the total output was used for domestic heating in 1944..

The principal byproducts of medium- and low-temperature carbonization plants are crude coal tar and gas. It is to be noted that the average yield of these byproducts per ton of coal charged differs greatly from that of high-temperature byproduct-coke ovens. Crude tar yield averaged 10.71 gallons compared with 8.13 gallons for byproduct ovens, whereas the gas yield was the reverse and averaged 7.06 M cubic feet compared with 10.68 M cubic feet. In 1944, the total value of coke and breeze produced and byproducts sold was \$2,154,911.

GAS-HOUSE COKE

The production of coke from coal-gas retorts in 1944 totaled 878,632 tons valued at \$7,078,113, an increase of 2 percent in output and 5 percent in value over 1943. Vertical retorts and miniature gas ovens furnished 55 percent of the output, and the remainder was produced in horizontal retorts. Gas-house coke was produced at 90 plants operating in 27 States compared with returns from 95 producers in the same States in 1943. In order of putput the leading States were Massachusetts, Wisconsin, New York, Pennsylvania, and Michigan; they supplied 67 percent of the total.

The disposal of gas-house coke in 1944 followed in general the pattern established in previous years, and 45 percent of the production was consumed at producing plants. Of the quantity used by producers, 48 percent was used for heating benches, 36 percent for making water gas, and the remaining 16 percent for making producer gas, raising steam, heating buildings, and other miscellaneous uses. The shortage of solid fuels for domestic purposes in certain areas directed attention to available supplies of gas-house coke. Sales for domestic use amounted to 423,675 tons (90 percent) of the total deliveries. Sales for use in the manufacture of water gas and other industrial purposes were not extensive and accounted for the balance—49,823 tons.

Additional data on coal-gas plants are given in Bureau of Mines Mineral Market Report M. M. S. 1280.

TABLE 45.—*Salient statistics of the coal-gas industry in the United States in 1944*

	Horizontal retorts	Vertical retorts and gas ovens	Total
Coke produced:			
Quantity.....net tons..	397,302	481,330	878,632
Value.....	\$3,136,462	\$3,941,651	\$7,078,113
Screenings or breeze produced:			
Quantity.....net tons..	29,817	74,092	103,909
Coal charged into retorts:			
Quantity.....do....	641,551	804,931	1,446,482
Value.....	\$4,228,755	\$5,312,711	\$9,541,466
Average per ton.....	\$6.59	\$6.60	\$6.60
Average yield in percent of coal charged:			
Coke.....	61.93	59.80	60.74
Breeze (at plants actually recovering).....	7.32	9.57	8.79
Retorts:			
In existence December 31.....	2,384	1,600	2,984
In operation December 31.....	1,858	1,565	2,421
Annual coal capacity.....net tons..	928,195	943,525	1,871,720
Coke used by producer—			
For manufacture of water gas:			
Quantity.....do....	86,965	53,872	140,837
Value.....	\$696,025	\$444,657	\$1,142,682
For manufacture of producer gas:			
Quantity.....net tons..		34,299	34,299
Value.....		\$163,924	\$163,924
For bench fuel:			
Quantity.....net tons..	105,060	84,331	189,391
Value.....	\$758,319	\$677,019	\$1,435,338
For other purposes:			
Quantity.....net tons..	19,079	10,335	29,414
Value.....	\$128,051	\$78,399	\$206,450
Coke sold to other consumers—			
For manufacture of water gas:			
Quantity.....net tons..	12,333	12,748	25,081
Value.....	\$100,048	\$101,258	\$201,306
For domestic use:			
Quantity.....net tons..	161,058	262,617	423,675
Value.....	\$1,366,594	\$2,276,708	\$3,643,302
For other industrial use:			
Quantity.....net tons..	12,250	12,492	24,742
Value.....	\$77,596	\$108,459	\$186,055
Stocks on January 1, 1945:			
Coke.....net tons..	22,960	48,566	71,526
Breeze.....do....	4,933	20,362	25,295
Byproducts produced—			
Tar:			
Production.....gallons..	7,799,255	11,919,878	19,719,133
Sales.....do....	7,561,897	11,504,726	19,066,623
Value.....	\$345,350	\$565,481	\$910,831
Stocks on January 1, 1945.....gallons..	3,121,493	2,324,934	5,446,427
Per ton of coal charged.....do....	12.16	14.81	13.36
Ammonia liquor (NH₃ content):			
Production.....pounds..		1,280,060	1,280,060
Sales.....do....		1,297,718	1,297,718
Value.....		\$37,655	\$37,655
Stocks on January 1, 1945.....pounds..		128,028	128,028
Per ton of coal charged.....do....		3.36	3.36
Other byproducts:³			
Value.....	\$812	\$16,675	\$17,487

¹ Includes 26 gas ovens.² Includes 15 gas ovens.³ Comprises drip and holder oil and retort carbon.

COKE-OVEN BYPRODUCTS

SUMMARY OF BYPRODUCTS

When coal is heated well above its decomposition temperature in byproduct-coke ovens it yields, in addition to "coke," the porous residue, a considerable quantity of gaseous material from which are recovered the principal byproducts—tar, ammonia, light oil, and gas. From these primary byproducts, a wide variety of materials essential to the national economy are manufactured by a chain of industrial

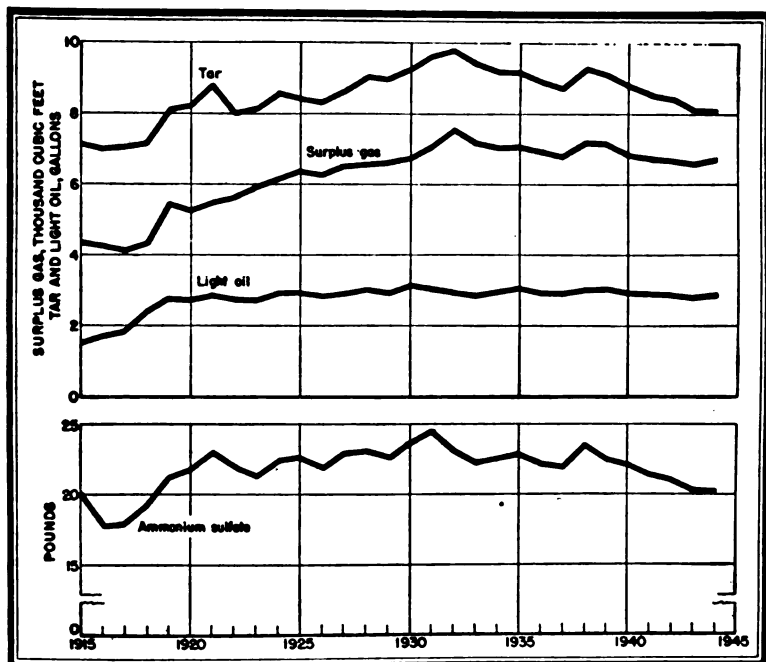


FIGURE 2.—Average yield of principal byproducts per net ton of coal carbonized in byproduct-coke ovens, 1915-44. Figures for light oil represent average at plants recovering light oil.

processes. By virtue of this fact, there exists a definite relationship between the coal-carbonization industry and countless other industries that depend directly or indirectly on this source of supply for raw material for their use. Crude coal tar, ammonia, light oil, and gas are the principal raw materials for the manufacture of perfumes, dyes, pharmaceuticals, explosives, fertilizers, plastics, and other chemicals required in the manufacture of aviation gasoline and synthetic rubber. The gross value of all byproducts sold increased 2 percent over 1943 and was equivalent to 39 percent of the value of the byproduct coke produced. This value does not include the value of breeze produced nor tar used as fuel by producers.

TABLE 46.—Byproducts obtained from coke-oven operations in the United States in 1944¹

[Exclusive of screenings or breeze]

Product	Production	Sales			On hand Decem- ber 31
		Quantity	Value		
			Total	Aver- age	
Tar.....gallons..	767,807,171	407,189,447	\$21,897,933	\$0.064	35,043,093
Tar derivatives:					
Creosote oil, distillate as such.....do....	31,849,034	31,931,611	3,858,798	.121	389,235
Creosote oil in coal-tar solution.....do....	11,930,287	10,493,286	1,237,190	.118	400,884
Tar acid oil.....do....	13,432,236	13,405,255	1,582,551	.118	534,383
Pitch of tar:					
Soft ² net tons..	379,671	52,641	571,631	10.859	9,011
Hard ³ do....	289,553	23	506	22.000	600
Other tar derivatives.....do....			1,998,544		
Ammonia:					
Sulfate.....pounds..	1,636,487,509	1,553,923,139	19,828,483	.013	138,061,389
Liquor (NH ₃ content).....do....	63,329,672	60,008,642	1,914,785	.032	1,697,337
			21,743,268		
Sulfate equivalent of all forms.....do....	1,889,806,197	1,793,957,707			144,860,737
NH ₃ equivalent of all forms.....do....	472,451,556	448,489,426			36,212,684
Gas:					
Used under boilers, etc.....M cubic feet..	1,008,799,926	30,111,380	2,645,851	.088	
Used in steel or affiliated plants.....do....		384,933,114	41,946,422	.109	
Distributed through city mains.....do....		170,313,905	44,694,854	.262	
Sold for industrial use.....do....		35,803,212	4,835,273	.135	
	1,008,799,926	621,161,611	94,122,400	.152	
Light oil and derivatives:					
Crude light oil.....gallons..	267,861,984	21,872,366	1,817,804	.063	3,483,337
Benzol:					
All grades except motor.....do....	146,909,883	145,106,318	19,021,111	.131	4,190,144
Motor.....do....	18,556,555	17,289,409	1,547,410	.089	966,586
Toluol, crude and refined.....do....	33,528,232	32,686,247	8,856,183	.271	1,075,139
Xylol, crude and refined.....do....	8,668,740	8,903,131	2,283,754	.257	388,348
Solvent naphtha.....do....	5,564,012	5,348,188	787,481	.147	413,754
Other light-oil products.....do....	9,209,261	6,275,973	604,282	.096	349,010
	222,436,683	237,481,632	34,918,025	.147	
Naphthalene, crude.....pounds..	103,041,023	103,839,789	2,094,586	.020	2,066,214
Carbolic oil, light and heavy.....gallons..	1,476,828	1,479,604	155,492	.105	80,918
Pyridine:					
Crude.....do....	485,261	434,442	304,830	.701	77,110
Refined.....do....	135,091	135,180	471,814	3.490	4,257
Picoline.....do....	104,852	103,714	131,366	1.267	23,518
Sodium phenolate.....do....	3,317,770	3,212,981	186,965	.058	107,987
Other byproducts ⁴ do....			722,633		
Value of all byproducts sold.....do....			185,995,242		

¹ Includes products of tar distillation conducted by coke-oven operators under same corporate name.² Softening point less than 110° F.³ Softening point over 160° F. Includes some medium pitch of tar reported by one producer.⁴ Includes gas used for heating ovens and gas wasted.⁵ Refined on premises to make derived products shown: 259,544,535 gallons.⁶ Total gallons of derived products.⁷ Ammonium thiocyanate, cyanogen sludge, dicyclopentadiene, hexane, phenol from sources other than tar distillation, residuals, sodium prussiate, sulfur, and vented vapors.⁸ Exclusive of value of breeze production, which was \$13,281,342 in 1944.

Crude coal tar and tar derivatives.—Production of crude coal tar increased 4 percent over 1943 and reached an all-time high of 767,-807,171 gallons. The principal uses of tar are as a raw material for the manufacture of coal-tar products, as a fuel for open-hearth furnaces or other metallurgical operations, and as a fuel under boilers. Of the total quantity sold or used by the producers for refining, coke-oven operators processed 26 percent on the premises compared with 22 percent in 1940, which reflects the expansion in tar-distilling facili-

ties that has been made at coke plants since the start of the war. The War Production Board granted exceptions to Conservation Order M-297 to some steel plants where a shortage of fuel oil existed so that 81 percent more tar was burned in 1944 than in 1943.

Ceiling prices on crude tar were continued throughout 1944 under provisions of Maximum Price Regulation 447, issued by the Office of Price Administration in 1943.

The constituents are separated from the crude coke-oven tar either in batch stills or by fractional distillation in continuous stills. Production of creosote, a derivative largely used for impregnating lumber, increased slightly over the output of the preceding year and reached 43,779,321 gallons. The value of sales of creosote accounted for 55 percent of the total revenue received by coke-oven operators from the sales of all tar derivatives. Tar-acid oil production and sales as such ranked next to creosote in quantity and value. Pitch-of-tar changed only slightly from the preceding year as regards output and was used primarily as fuel.

Ammonia.—Ammonia was recovered at 85 of the 88 active by-product-coke plants in 1944, 66 of which made ammonium sulfate and 23 ammonia liquor (4 plants produced both sulfate and liquor), some of which was purified in order to remove sulfides, carbonates, and pyridine. The total production of ammonia (NH_3 equivalent of all forms) amounted to 472,451,549 pounds, or 5.07 pounds per ton of coal carbonized. Fully 87 percent of the total ammonia recovered was converted to ammonium sulfate, which was sold for use as a fertilizer. Sales of ammonium sulfate, which remained under allocation throughout the year, totaled 1,553,923,139 pounds, approximately the same as the preceding year. However, the allocations of ammonium sulfate were considerably lower than production, and producers' stocks increased more than 143 percent during the year. To relieve the pressure of excessive stocks in the hands of producers, the War Production Board, in a letter dated November 19, notified all fertilizer manufacturers east of the Rocky Mountains that allocations of ammonium sulfate would be increased by one-twelfth above their original quota. The entire increase could be taken in January 1945 or, if the buyer preferred, distributed over the first quarter of the year.

The price of ammonium sulfate during the war period has remained unchanged under provisions of Maximum Price Regulation 205 established in 1942 and revised June 30, 1944.

Gas.—Approximately 17 percent by weight of the coals charged into high-temperature byproduct-coke ovens is recovered in the form of fuel gas. Usually about 37 percent of the gas output is used to heat the ovens, and the remainder is consumed by affiliated metallurgical works, neighboring industries, and public utilities. The yield of gas in 1944 remained the same as in 1943, but owing to the increased quantity of coal charged into ovens total output increased 5 percent over the preceding year and soared to a new all-time high. The gain made available a greater quantity of surplus gas, and that used or sold for industrial purposes and distributed through city mains increased 5 percent in volume and \$5,502,215 in value over 1943. The value of surplus gas was equivalent to 51 percent of the total value of all byproducts sold or used by the producers.

The average unit value of the surplus gas as reported by operators, which has declined steadily from \$0.187 per M cubic feet in 1938 to

\$0.150 in 1943, rose to \$0.152 in 1944. The average unit value of surplus gas sold or used by producers is governed largely by the ratio of gas sold for distribution through city mains, since this gas always commands higher prices than that used under boilers or in steel or affiliated plants.

Crude light oil and light-oil derivatives.—Crude light oil is a term used in the byproduct industry to designate the mixture of all those condensable products derived from the coking process, the boiling points of which do not exceed 200° C. It consists principally of benzol, toluol, and their homologs. The potential yield of crude light oil per ton of coal varies widely, depending on the quality of coal charged, design and condition of ovens, oven temperatures, coking time, and kind of scrubbing equipment. In 1944 the yield per ton of coal carbonized at individual plants recovering light oil ranged from 2.06 gallons to 4.04 and averaged 2.87 gallons compared with 2.83 gallons in 1943. Total output increased 7 percent over 1943 to 267,861,984 gallons. Production of benzol (all grades), the principal constituent of light oil, increased 8 percent over 1943. More than 87 percent of the benzol produced was refined into 1° and 2° grades, which are used principally for the production of cumene, employed in the enrichment of aviation gasoline, and of styrene, employed as an essential component in compounding synthetic rubber.

The production of toluol has increased steadily in recent years and in 1944 totaled 33,528,232 gallons. This output was but approximately one-fourth of the total output for the country, as production of toluol from the refining of petroleum has increased tremendously since 1942, and according to preliminary figures reported to the United States Tariff Commission the production from this source, exclusive of that produced under ordnance control, totaled 96,000,000 gallons in 1944.

The combined production of xylol, solvent naphtha, and other light-oil derivatives increased 2 percent over 1943. The prices for benzol, toluol, and xylol did not vary from the previous year; however, on July 15, 1944, the Office of Price Administration issued Amendment 66 to General Maximum Price Regulation which placed sales of benzol, toluol, and xylol, formerly exempted when sold for the manufacture of synthetic rubber and aviation gasoline, under price control at the level of March 1942. Sales of benzol, toluol, and xylol produced from petroleum and sales of benzol by the Defense Supplies Corporation remained exempt.

TABLE 47.—*Coal equivalent of byproducts of byproduct coking in the United States, 1913, 1914, 1918, 1937, and 1943-44*

Year	Quantity of byproducts				Rough equivalent in heating value (billion B. t. u.)					Coal equivalent	
	(1) Coke breeze (thousand net tons)	(2) Surplus gas (billion cubic feet)	(3) Tar produced (thousand gallons)	(4) Light oil produced (thousand gallons)	(5) Coke breeze (1 x 20)	(6) Surplus gas (2 x 550)	(7) Tar (3 x 0.150)	(8) Light oil (4 x 0.130)	(9) Total (5+6+7+8)	(10) Net tons (9+0.0262)	(11) Percent this forms of coal made into coke
1913.....	735	64	115, 145	3, 000	14, 700	35, 200	17, 272	390	67, 562	2, 600, 000	3.8
1914.....	667	61	109, 901	8, 464	13, 340	33, 550	16, 485	1, 100	64, 475	2, 461, 000	4.8
1918.....	1, 999	158	263, 299	87, 562	39, 980	86, 900	39, 495	11, 383	177, 758	6, 785, 000	8.9
1937.....	3, 884	463	603, 053	187, 054	77, 680	254, 650	90, 468	24, 317	447, 105	17, 065, 000	22.0
1943.....	4, 790	592	738, 167	250, 511	95, 800	325, 600	110, 725	32, 566	564, 691	21, 553, 000	21.0
1944.....	4, 965	621	767, 807	267, 862	99, 300	341, 550	115, 171	34, 822	590, 843	22, 551, 000	21.4

COKE-OVEN GAS

TABLE 48.—*Coke-oven gas produced and sold in the United States in 1944, by States*

State	Active plants	Produced (M cubic feet)	Used in heating ovens (M cubic feet)	Surplus sold or used		Wasted (M cubic feet)	
				M cubic feet	Value		
					Total		Average
Alabama.....	7	88, 470, 186	39, 579, 100	46, 303, 486	\$4, 087, 051	\$0.088	2, 587, 600
California.....	1	6, 322, 829	785, 525	4, 936, 483	(1)	(1)	600, 821
Colorado.....	1	12, 260, 534	6, 168, 953	6, 028, 876	(1)	(1)	62, 705
Illinois.....	9	54, 864, 282	17, 350, 663	36, 465, 886	5, 441, 700	.149	1, 047, 733
Indiana.....	5	125, 044, 705	53, 821, 805	68, 956, 074	11, 664, 843	.169	2, 266, 826
Maryland.....	1	26, 770, 161	8, 892, 594	17, 516, 387	(1)	(1)	361, 180
Massachusetts.....	2	18, 193, 058	3, 439, 140	14, 717, 456	(1)	(1)	36, 462
Michigan.....	5	42, 565, 326	7, 222, 414	35, 191, 047	5, 220, 339	.148	151, 865
Minnesota.....	3	13, 280, 183	5, 606, 346	7, 602, 578	1, 898, 761	.250	71, 259
New Jersey.....	2	16, 096, 354	3, 429, 445	12, 666, 909	(1)	(1)	.....
New York.....	8	91, 178, 994	25, 755, 152	64, 084, 692	17, 085, 922	.267	1, 339, 150
Ohio.....	15	147, 228, 831	63, 927, 941	81, 219, 389	9, 773, 273	.120	2, 081, 501
Pennsylvania.....	13	266, 723, 779	108, 948, 671	156, 783, 296	18, 104, 951	.115	991, 812
Tennessee.....	1	2, 877, 154	1, 239, 452	1, 615, 892	(1)	(1)	21, 810
Texas.....	2	2, 720, 000	1, 024, 580	923, 434	(1)	(1)	771, 986
Utah.....	2	18, 319, 833	7, 010, 490	10, 062, 342	(1)	(1)	1, 247, 001
West Virginia.....	5	41, 875, 189	11, 951, 268	29, 539, 739	2, 628, 876	.069	384, 182
Connecticut, Kentucky, Mis- souri, Rhode Island, and Wisconsin.....	6	34, 008, 528	6, 870, 582	26, 547, 645	5, 789, 900	.218	590, 301
Undistributed.....	.....	.....	.....	.....	12, 426, 784	.181	.....
Total, 1944.....	88	1, 008, 799, 926	373, 024, 121	621, 161, 611	94, 122, 400	.152	14, 614, 194
At merchant plants.....	35	208, 546, 386	48, 108, 545	157, 746, 460	39, 601, 952	.251	2, 691, 381
At furnace plants.....	53	800, 253, 540	324, 915, 576	463, 415, 151	54, 520, 448	.118	11, 922, 813
Total, 1943.....	90	960, 454, 518	350, 762, 774	592, 275, 374	88, 620, 185	.150	17, 416, 370

¹ Included under "Undistributed."

TABLE 49.—*Disposal of surplus coke-oven gas in the United States in 1944, by States*

State	Used by producer—				Sold			
	Under boilers		In steel or other affiliated plant		Distributed through city mains		For industrial purposes	
	M cubic feet	Value	M cubic feet	Value	M cubic feet	Value	M cubic feet	Value
		Total		Total		Total		Total
		Aver- age		Aver- age		Aver- age		Aver- age
Alabama.....	7,739,142	\$333,656	\$0.043	\$2,807,046	7,893,995	\$842,371	1,137,766	\$103,978
California.....								
Colorado.....								
Illinois.....	2,786,038	278,535	.100	1,423,879	21,933,064	3,603,627	1,493,020	135,659
Indiana.....	2,960,840	288,080	.097	6,706,817	7,539,336	3,735,982	2,559,193	873,964
Maryland.....								
Massachusetts.....	16,902	(1)	(1)	(1)	14,549,527	(1)	150,021	(1)
Michigan.....	3,731,735	492,751	.132	4,084,563	73,875	25,324	3,511,780	617,701
Minnesota.....	374,476	20,952	.056	411,012	12,646,798	1,466,797		
New Jersey.....								
New York.....								
Ohio.....	2,114,587	228,349	.108	2,046,248	43,349,338	14,365,761	2,713,076	425,364
Pennsylvania.....	3,225,694	312,182	.097	7,278,261	7,316,499	1,459,328	7,165,217	723,502
Tennessee.....	4,134,542	424,174	.103	11,793,567	18,793,032	4,536,161	11,223,060	1,361,049
Texas.....	249,220	(1)	(1)	(1)	1,366,672	(1)		
Utah.....	200,000	(1)	(1)	(1)				
West Virginia.....	1,372,683	3,209	.065	7,721,274	766,917	(1)	201,468	(1)
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin.....	1,156,386	128,359	.111	2,338,017			2,206,014	287,650
Undistributed.....		135,904	.074	3,007,012	21,949,292	5,415,362	3,441,967	246,179
Total, 1944.....	30,111,380	2,645,851	.088	41,946,422	170,313,905	44,694,854	35,903,212	4,835,273
At merchant plants.....	6,801,260	530,472	.078	1,284,546	116,613,851	34,707,240	21,218,839	3,099,694
At furnace plants.....	23,310,120	2,115,379	.091	40,681,876	53,699,954	9,987,614	14,584,373	1,735,579
Total, 1945.....	29,628,628	\$2,317,836	*.081	\$36,416,497	169,768,941	44,594,210	37,197,507	5,292,642

* Included under "Undistributed."

† Revised figure.

TABLE 50.—Coke-oven gas and other kinds of gas used in heating byproduct ovens in the United States in 1944, by States, in M cubic feet

State	Coke-oven gas	Producer gas		Blue-water gas		Blast-furnace gas		Other gas		Total coke-oven gas equivalent
		Total	Coke-oven gas equivalent	Total	Coke-oven gas equivalent	Total	Coke-oven gas equivalent	Total	Coke-oven gas equivalent	
Alabama.....	39,579,100	.....	.....	.....	.....	.....	.....	.....	.....	39,579,100
California.....	785,525	.....	.....	.....	.....	8,663,260	1,468,349	.....	.....	2,243,874
Colorado.....	6,168,953	.....	.....	.....	.....	.....	.....	.....	.....	6,168,953
Illinois.....	17,550,653	.....	.....	.....	.....	31,837,567	5,398,199	11,452,551	2,905,192	96,688,859
Indiana.....	53,821,805	4,228,960	1,006,865	.....	.....	.....	.....	5,592,359	2,692,541	57,440,427
Maryland.....	8,802,894	.....	.....	1,666,946	926,081	.....	.....	.....	.....	8,892,594
Massachusetts.....	3,439,140	.....	.....	.....	.....	.....	.....	.....	.....	4,714,618
Michigan.....	7,222,414	5,357,008	1,275,478	.....	.....	54,211,114	9,188,325	.....	.....	16,787,221
Minnesota.....	5,606,346	1,403,010	334,050	76,378	42,432	.....	.....	.....	.....	16,758,492
New Jersey.....	3,429,445	13,478,748	3,209,226	.....	.....	.....	.....	.....	.....	6,638,671
New York.....	25,755,152	48,165,303	11,467,929	892,888	496,049	3,004,169	509,181	.....	.....	38,228,311
Ohio.....	63,927,941	.....	.....	.....	.....	11,787,180	1,997,827	.....	.....	63,947,048
Pennsylvania.....	108,948,671	6,493,370	1,546,040	.....	.....	.....	.....	7,738,025	2,108,643	114,601,181
Tennessee.....	1,239,452	.....	.....	.....	.....	222,420	37,668	.....	.....	1,239,452
Texas.....	1,024,580	.....	.....	.....	.....	5,383,808	912,509	1,180,000	360,000	1,429,278
Utah.....	7,010,490	.....	.....	.....	.....	16,585,370	2,811,080	1,953,042	.....	7,922,999
West Virginia.....	11,951,268	.....	.....	.....	.....	.....	.....	.....	.....	16,264,688
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin.....	6,870,562	18,400,446	4,381,059	.....	.....	.....	.....	1,009,793	2,019,586	13,271,227
At merchant plants.....	373,024,121	98,157,460	23,370,823	2,638,212	1,464,562	131,807,623	22,340,275	5,925,770	11,588,212	431,787,993
At furnace plants.....	48,108,545	97,334,146	23,174,796	2,638,212	1,464,562	.....	.....	6,745,770	11,228,212	83,978,115
	824,915,576	823,314	196,027	.....	.....	131,907,623	22,340,275	180,000	360,000	347,811,578

1 Natural gas.

2 Propane.

3 Oil gas.

4 Spillage gas.

TAR

TABLE 51.—Coke-oven tar produced, used by producer, and sold in the United States in 1944, by States

State	Produced (gallons)		Used by producer (gallons)						Sold			On hand Dec. 31 (gallons)
	Total	Per ton of coal coked	For refin- ing or topping ¹	As fuel under boilers	In open hearth or affiliated plants	Other- wise	For use as fuel ² (gallons)	For refin- ing into tar products (gallons)	Total			
									Gallons	Value		
										Total	Average	
Alabama.....	65 810 296	8.31	(³)	279,233	22 716 102	131,934	—	40 391 759	40 391 759	\$2 271 072	\$0.056	3 330 017
California.....	6 135 207	10.71	(⁴)	—	—	—	—	—	126 975	(⁵)	(⁶)	133 737
Colorado.....	10 719 000	10.60	(⁴)	2 500	—	1 700	7 010 348	30 800 038	37 810 366	2 023 083	0.054	234 499
Illinois.....	38 098 522	6.95	(⁴)	—	11 477 836	3 163 577	7 299 361	35 012 877	42 312 238	2 190 174	0.052	1 900 016
Indiana.....	70 236 351	5.82	—	—	—	1 045	—	22 691 796	22 691 796	(⁵)	(⁶)	3 576 200
Maryland.....	21 361 296	7.56	—	—	—	—	—	12 890 127	12 890 127	(⁵)	(⁶)	1 946 726
Massachusetts.....	12 921 533	7.73	—	—	—	—	—	25 002 667	25 002 667	1 297 716	0.052	1 143 918
Michigan.....	30 472 726	7.36	—	—	5 014 535	9	—	8 241 807	10 724 682	(⁵)	(⁶)	2 664 739
Minnesota.....	8 197 928	6.56	—	—	—	27 000	—	10 724 682	10 724 682	(⁵)	(⁶)	683 843
New Jersey.....	11 029 574	7.63	—	—	—	—	—	47 219 593	47 957 239	2 693 302	0.056	787 292
New York.....	72 134 220	8.35	(⁴)	—	8 023 077	159 164	737 641	54 304 508	54 304 508	2 998 579	0.055	3 972 183
Ohio.....	106 997 204	7.44	—	580 842	48 232 066	827 371	—	33 213 590	33 835 978	1 741 836	0.051	4 535 383
Pennsylvania.....	232 612 653	9.59	147 566 248	—	51 066 394	851 015	637 383	2 068 037	2 068 037	(⁵)	(⁶)	8 931 925
Tennessee.....	2 064 524	6.51	—	—	—	—	—	1 838 296	1 838 296	(⁵)	(⁶)	31 017
Texas.....	2 430 529	6.33	—	—	—	249	—	1 400 235	1 400 235	(⁵)	(⁶)	359 333
Virginia.....	14 238 577	10.39	—	—	9 565 864	2 316	166 274	38 686 437	38 686 437	2 138 996	0.055	589 333
West Virginia.....	38 766 442	10.28	—	—	—	605	—	23 681 306	23 681 306	1 232 559	0.052	868 468
Wisconsin.....	23 780 454	7.72	53 003 836	—	—	—	—	23 681 306	23 681 306	2 844 566	0.052	855 147
Undistributed.....	—	—	—	—	—	—	—	—	—	—	—	—
Total, 1944.....	767 807 171	8.13	200 570 064	862 575	156 735 874	5 165 985	15 851 012	391 338 435	407 189 447	21 897 933	0.054	24 043 098
At merchant plants.....	160 233 834	8.19	1 963 733	—	—	658 906	—	157 721 993	157 721 993	8 171 066	0.052	5 926 321
At furnace plants.....	607 573 337	8.11	198 606 331	862 575	156 735 874	4 507 079	15 851 012	233 616 442	249 467 454	13 726 847	0.055	20 116 772
Total, 1943.....	738 166 968	8.11	204 627 996	1 972 067	85 228 784	4 422 551	14 779 631	440 859 215	445 638 846	24 569 762	0.054	27 146 107

¹ Includes 279,731 gallons of benzol still residue.² Comprises 688,211 gallons of tar sold to affiliated corporations and 15,162,801 gallons sold to other purchasers.³ Included under "Undistributed."⁴ Includes 19,221,855 gallons of crude tar sold to affiliated coke plants, which is included in the tar used by producer for refining or topping.

AMMONIA

TABLE 52.—Coke-oven ammonia produced and sold in the United States in 1944, by States

State	Active plants	Sulfate equivalent of all forms (pounds)		Produced as—		Sold as—				On hand December 31 (pounds)	
		Total	Per ton of coal coked	Sulfate (pounds)	Liquor (NH ₃ content) (pounds)	Sulfate		Liquor (NH ₃ content)		Sulfate	Liquor (NH ₃ content)
						Pounds	Value	Pounds	Value		
Alabama.....	7	186,641,338	23.56	169,917,138	4,156,050	164,698,305	\$2,242,966	4,221,137	\$161,124	6,337,363	49,452
California.....	1	15,711,440	27.43	15,711,440	---	16,441,280	(¹)	---	---	206,000	---
Colorado.....	1	23,106,612	22.85	23,106,612	---	22,314,262	(¹)	---	---	1,331,620	---
Illinois.....	9	102,908,705	18.77	85,176,857	4,432,962	79,528,987	999,445	4,521,205	(¹)	8,178,743	101,381
Indiana.....	5	207,229,386	17.18	179,537,674	6,922,928	168,426,924	2,052,612	6,855,335	197,293	13,888,874	295,892
Maryland.....	1	57,697,156	20.42	57,697,156	---	55,161,640	(¹)	---	---	6,559,744	---
Massachusetts.....	2	29,242,632	17.50	24,815,700	1,106,733	22,786,400	(¹)	1,116,823	(¹)	---	---
Michigan.....	5	84,301,771	20.36	28,896,087	13,851,421	28,500,345	(¹)	11,792,620	(¹)	2,285,300	8,550
Minnesota.....	3	21,919,324	17.55	21,919,324	---	21,472,945	281,611	---	---	427,440	280,823
New Jersey.....	2	26,147,791	18.09	26,147,791	---	26,254,980	(¹)	---	---	1,054,782	---
New York.....	8	165,410,552	19.15	132,862,244	8,207,077	127,407,134	1,719,005	7,895,945	257,074	13,243,311	316,167
Ohio.....	15	277,817,114	19.31	222,651,322	13,791,448	223,206,732	2,705,217	12,797,515	424,410	3,879,411	326,002
Pennsylvania.....	13	694,964,795	21.65	621,972,235	748,135	473,421,505	6,764,331	7,717,548	(¹)	75,220,359	19,311
Tennessee.....	1	6,943,426	22.69	6,943,426	---	6,937,200	(¹)	---	---	96,026	---
Texas.....	2	6,198,764	23.36	6,198,764	---	6,039,900	(¹)	---	---	158,864	---
Utah.....	2	34,091,487	24.89	34,091,487	---	33,513,750	(¹)	---	---	1,331,007	---
West Virginia.....	3	59,181,021	23.52	59,181,021	---	58,483,160	712,808	---	---	1,377,796	---
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin.....	5	60,392,893	19.83	19,941,211	10,112,918	19,307,680	265,322	10,090,814	310,554	1,215,518	290,769
Undistributed.....							3,125,108		574,330		
Total, 1944.....	85	1,869,806,197	20.29	1,636,487,809	63,329,672	1,553,922,139	19,828,463	60,008,642	1,914,785	138,061,389	1,697,337
At merchant plants.....	32	370,018,640	20.31	219,005,793	37,978,214	214,040,989	2,927,240	41,008,791	1,283,010	11,402,800	1,226,170
At furnace plants.....	53	1,518,867,548	20.28	1,417,481,716	25,351,458	1,339,882,180	16,901,223	19,001,851	631,775	126,658,589	471,167
Total, 1943.....	83	1,795,386,007	20.32	1,622,539,911	68,211,624	1,549,629,066	20,004,725	64,654,062	2,407,450	56,794,743	1,982,763

¹ Included under "Undistributed."

LIGHT OIL AND ITS DERIVATIVES

TABLE 53.—Coke-oven crude light oil produced in the United States and derived products obtained and sold in 1944, by States

State	Active plants	Produced (gallons)		Refined on premises ¹ (gallons)	Derived products obtained and sold			On hand Dec. 31 (gallons)
		Total	Per ton of coal cooked		Produced (gallons)	Sold ²		
						Gallons	Value	
Alabama.....	7	22,553,373	2.85	22,482,885	19,710,704	19,009,315	\$2,879,517	308,375
California.....	1	2,214,780	3.87	2,225,573	2,020,907	1,796,228	(³)	10,070
Colorado.....	1	3,599,427	3.56	3,611,867	2,989,658	2,734,149	(³)	9,160
Illinois.....	7	13,986,578	2.68	8,204,230	7,053,834	6,991,693	1,058,117	168,195
Indiana.....	5	29,208,014	2.42	31,928,000	28,069,626	27,685,908	4,128,057	308,405
Maryland.....	1	11,428,286	4.04	11,486,799	9,502,818	9,673,649	(³)	62,144
Michigan.....	4	11,620,925	2.85	5,303,538	4,536,496	4,572,799	698,094	122,570
New York.....	8	21,554,328	2.50	35,375,781	30,996,461	31,291,364	4,844,036	222,358
Ohio.....	15	41,107,887	2.86	36,377,054	29,385,345	28,196,523	4,314,499	449,315
Pennsylvania.....	13	74,831,936	3.09	73,506,302	63,603,694	61,673,517	9,354,996	926,870
Tennessee.....	1	811,749	2.65	970,090	873,297	704,313	(³)	6,443
Texas.....	2	546,384	2.06	529,884	453,122	411,714	(³)	16,500
Utah.....	2	4,359,167	3.18	4,203,289	3,225,347	3,037,826	(³)	165,078
West Virginia.....	5	13,752,731	3.65	12,200,069	10,574,093	8,870,000	1,445,468	252,125
Connecticut, Kentucky, Massachusetts, Minnesota, Missouri, New Jersey, and Wisconsin.....	9	16,286,419	2.42	11,139,174	9,441,281	8,960,268	1,475,435	455,729
Undistributed.....							2,902,002	
Total, 1944.....	81	267,861,984	2.87	259,544,535	222,436,683	215,609,266	33,100,221	3,483,337
At merchant plants.....	29	46,901,907	2.44	46,072,054	40,580,242	38,192,745	5,880,416	1,326,969
At furnace plants.....	52	220,960,077	2.62	213,472,481	181,856,441	177,416,521	27,219,805	2,156,368
Total, 1943.....	78	250,511,095	2.83	245,893,002	208,932,084	204,623,626	31,144,456	3,948,929

¹ Comprises 241,060,921 gallons of crude light oil made on premises and 18,483,614 gallons purchased from other coke oven plants.

² Excludes 21,872,366 gallons of crude light oil valued at \$1,817,804, sold as such.

³ Included under "Undistributed."

NAPHTHALENE

TABLE 54.—Crude naphthalene produced and sold by byproduct-coke-oven operators in the United States, 1940-44

Year	Produced (pounds)	Sold			Receipts per ton of coke (cents)
		Pounds	Value		
			Total	Average per pound (cents)	
1940.....	72,426,443	72,522,476	\$1,248,051	\$0.017	\$0.023
1941.....	84,046,676	83,879,396	1,522,518	.018	.026
1942.....	95,612,788	95,039,639	1,941,626	.020	.031
1943.....	98,096,899	98,031,058	2,088,829	.021	.033
1944.....	103,041,023	103,839,789	2,094,596	.020	.031

BYPRODUCT-COKE OVENS OWNED BY CITY-GAS COMPANIES (PUBLIC UTILITY PLANTS)

Production of coke at byproduct plants owned and operated by city-gas companies in 1944 decreased 2 percent below 1943 and was equivalent to 6 percent of the total byproduct-coke output.

At these plants, maximum production of coke-oven gas is generally desired, and more emphasis is placed upon the production of gas of proper analysis than upon the grade of coke obtained. Of the total coke-oven gas produced at public utility plants in 1944, 87 percent was distributed through city mains compared with 12 percent for all other plants. It will be noted in the following table that the average unit value of the surplus gas sold and used by public utility plants is considerably higher than at other plants. This is due largely to the great quantities of gas used by steel companies or affiliated plants operating coke ovens, and the value assigned for gas use is merely a credit value after manufacturing costs of coke and other byproducts are deducted.

In 1944, city-gas companies operated 15 byproduct-coke plants in 10 States. New York was the ranking State in number of city-gas plants, and the output of coke, gas, tar, and ammonia was 1,657,787 tons, 27,613,540 M cubic feet, 24,699,715 gallons, and 46,062,359 pounds, respectively.

A summary of the operations of city-gas or public utility plants in relation to the byproduct industry as a whole is presented in the following table:

TABLE 55.—Production of coke, breeze, gas, and byproducts in the United States at byproduct-coke plants owned by city-gas companies (public utilities ¹) and at all other byproduct-coke plants, 1943-44.

Product	1943			1944		
	Plants not owned by city-gas companies	Plants owned by city-gas companies (public utilities)	Total	Plants not owned by city-gas companies	Plants owned by city-gas companies (public utilities)	Total
Number of active plants....	74	17	91	73	15	88
Coke:						
Production.....net tons..	59,737,520	4,005,156	63,742,676	63,123,534	3,941,261	67,064,795
Value.....	\$391,508,237	\$32,616,892	\$424,125,129	\$444,655,387	\$34,188,785	\$478,844,172
Average per ton.....	\$6.55	\$8.14	\$6.65	\$7.04	\$8.67	\$7.14
Screenings or breeze:						
Production.....net tons..	4,476,352	313,217	4,789,569	4,616,609	348,455	4,965,064
Sales.....do.....	1,269,717	22,192	1,291,909	989,174	28,973	1,018,147
Value.....	\$3,857,203	\$62,873	\$3,920,076	\$3,158,350	\$85,778	\$3,244,128
Average per ton.....	\$3.04	\$2.83	\$3.03	\$3.19	\$2.96	\$3.19
Coal charged into ovens:						
Quantity.....net tons..	84,445,201	5,573,740	90,018,941	88,891,035	5,546,852	94,437,887
Coke:						
Used by producer:						
Quantity.....do.....	36,236,162	1,282,909	37,519,071	39,416,669	1,272,034	40,688,703
Value.....	\$234,982,819	\$8,628,110	\$243,610,929	\$272,972,118	\$8,818,105	\$281,790,223
Sold:						
Quantity.....net tons..	23,910,517	2,820,713	26,731,230	23,447,528	2,583,902	26,031,430
Value.....	\$160,567,898	\$24,787,457	\$185,355,355	\$169,546,156	\$24,612,363	\$194,158,519

See footnote at end of table.

TABLE 55.—*Production of coke, breeze, gas, and byproducts in the United States at byproduct-coke plants owned by city-gas companies (public utilities¹) and at all other byproduct-coke plants, 1943-44—Continued*

Product	1943			1944		
	Plants not owned by city-gas companies	Plants owned by city-gas companies (public utilities)	Total	Plants not owned by city-gas companies	Plants owned by city-gas companies (public utilities)	Total
Byproducts:						
Gas:						
Production..... M cubic feet...	898, 774, 771	61, 679, 747	960, 454, 518	947, 353, 784	61, 446, 142	1, 008, 799, 926
Sales of surplus:						
Used under boilers:						
Quantity M Cubic feet.....	28, 590, 534	88, 314	28, 678, 848	30, 098, 590	12, 800	30, 111, 390
Value.....	\$2, 808, 950	\$11, 886	\$2, 820, 836	\$2, 641, 817	\$4, 034	\$2, 645, 851
Average per M cubic feet.....	\$0. 081	\$0. 310	\$0. 081	\$0. 088	\$0. 315	\$0. 088
Used in steel or affiliated plants:						
Quantity..... M cubic feet...	356, 660, 078	-----	356, 660, 078	384, 933, 114	-----	384, 933, 114
Value.....	\$36, 416, 497	-----	\$36, 416, 497	\$41, 946, 422	-----	\$41, 946, 422
Average per M cubic feet.....	\$0. 102	-----	\$0. 102	\$0. 109	-----	\$0. 109
Distributed through city mains:						
Quantity..... M cubic feet...	116, 458, 904	53, 330, 037	169, 788, 941	116, 853, 680	53, 460, 225	170, 313, 905
Value.....	\$27, 444, 204	\$17, 150, 006	\$44, 594, 210	\$27, 209, 528	\$17, 485, 326	\$44, 694, 854
Average per M cubic feet.....	\$0. 236	\$0. 322	\$0. 263	\$0. 233	\$0. 327	\$0. 262
Sold for industrial use:						
Quantity..... M cubic feet...	32, 568, 881	4, 628, 626	37, 197, 507	31, 677, 493	4, 125, 719	35, 803, 212
Value.....	\$3, 827, 020	\$1, 465, 622	\$5, 292, 642	\$3, 443, 679	\$1, 391, 594	\$4, 835, 273
Average per M cubic feet.....	\$0. 118	\$0. 317	\$0. 142	\$0. 109	\$0. 337	\$0. 135
Tar:						
Production..... gallons...	688, 712, 749	49, 454, 219	738, 166, 968	719, 144, 950	48, 662, 221	767, 807, 171
Sales:						
Quantity..... do.....	406, 277, 899	49, 360, 947	455, 638, 846	358, 406, 879	48, 782, 568	407, 189, 447
Value.....	\$21, 928, 180	\$2, 641, 582	\$24, 569, 762	\$19, 280, 968	\$2, 616, 965	\$21, 897, 933
Ammonia:						
Production (NH ₃ equivalent of all forms)..... pounds...	422, 353, 696	26, 492, 806	448, 846, 502	447, 222, 749	25, 228, 800	472, 451, 549
Liquor (NH₃ content):						
Production..... pounds...	63, 213, 793	4, 997, 731	68, 211, 524	58, 166, 748	5, 162, 924	63, 329, 672
Sales..... do.....	59, 778, 192	4, 875, 870	64, 654, 062	54, 910, 512	5, 098, 130	60, 008, 642
Value.....	\$2, 265, 545	\$141, 905	\$2, 407, 450	\$1, 785, 452	\$129, 333	\$1, 914, 785
Sulfate:						
Production..... pounds...	1, 436, 559, 612	85, 980, 299	1, 522, 539, 911	1, 556, 224, 007	80, 263, 502	1, 636, 487, 509
Sales..... do.....	1, 464, 271, 206	85, 357, 860	1, 549, 629, 066	1, 476, 390, 430	77, 532, 709	1, 553, 923, 139
Value.....	\$19, 031, 112	\$1, 180, 554	\$20, 211, 666	\$18, 760, 775	\$1, 067, 708	\$19, 828, 483
Crude light oil:						
Production..... gallons...	242, 233, 948	8, 277, 147	250, 511, 095	269, 140, 334	8, 721, 650	267, 861, 984
Sales..... do.....	13, 853, 874	3, 341, 128	17, 195, 002	16, 907, 317	4, 965, 049	21, 872, 366
Value.....	\$1, 262, 921	\$288, 777	\$1, 551, 698	\$1, 418, 278	\$399, 526	\$1, 817, 804
Light oil derivatives:						
Production..... gallons...	203, 487, 830	5, 444, 254	208, 932, 084	218, 563, 989	3, 872, 694	222, 436, 683
Sales..... do.....	198, 995, 938	5, 627, 688	204, 623, 626	211, 799, 325	3, 809, 941	215, 609, 266
Value.....	\$30, 355, 787	\$788, 669	\$31, 144, 456	\$32, 653, 776	\$446, 445	\$33, 100, 221
Naphthalene, crude:						
Production..... pounds...	96, 616, 023	1, 480, 876	98, 096, 899	102, 174, 677	866, 346	103, 041, 023
Sales..... do.....	96, 447, 540	1, 583, 518	98, 031, 058	102, 947, 593	892, 196	103, 839, 789
Value.....	\$2, 059, 635	\$29, 194	\$2, 088, 829	\$2, 077, 968	\$16, 628	\$2, 094, 596
All other byproducts, value.....	\$11, 283, 440	\$62, 219	\$11, 345, 659	\$11, 145, 251	\$73, 769	\$11, 219, 020

¹ Byproduct ovens built by city-gas companies, some of which are operated in conjunction with coal, oil, and water-gas plants. Does not include independent byproduct plants which may sell gas to public utility companies for distribution.

FUEL BRIQUETS AND PACKAGED FUEL¹

By GERTRUDE S. GOODMAN

SUMMARY OUTLINE

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SUMMARY

For the sixth consecutive year the fuel-briquetting industry exceeded the previous year's production and in 1944 reached a new high of 2,464,961 net tons. On the other hand, production in the packaged-fuel industry decreased in each of the past 4 years, mainly because of wartime shortages in materials and labor. Packaged-fuel production in 1944 dropped to 175,770 tons.

At the beginning of the war in 1939, the briquetting industry was utilizing 28.0 percent of its total capacity; by the end of 1944 it had geared its wartime production to 70.6 percent.

The manufacture of briquetting equipment continued restricted through 1944, subject to approval and priorities by the War Production Board; used equipment, however, was not subject to priorities. The Board² reported that some changes in control might be possible after the close of the war in Europe.

In February 1944, Solid Fuels Administrator Harold L. Ickes, in connection with his distribution program, urged the fuel industry wherever possible to substitute Pennsylvania anthracite fines, of which there is a large surplus, for bituminous coal, the supply of which was low. The briquetting industry's response to this suggestion has resulted in an increase in the use of anthracite in 1944 of 322,416 tons, or 83 percent over 1943, and a decrease of 152,127 tons, or 11 percent, in bituminous coal used.

Price control by the Office of Price Administration prevented the spiraling of briquet prices in World War II³ such as occurred in the first World War. However, some packaged-fuel operators reported that ceiling prices made profitable operation impossible.

¹ Directories of fuel-briquetting and packaged-fuel plants operating in 1944 and names of manufacturers of equipment will be furnished on request by the Bureau of Mines, Washington 25, D. C.

² Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

³ Data on employment and principal expenses in the manufacture of fuel briquets may be obtained from the Bureau of the Census.

Briquets made from charcoal, wood scrap, and fruit pits are not included in Bureau of Mines review.

Records on fuel briquets collected since 1907 and on packaged fuel since 1935 published in earlier reports of this series.

⁴ American Mining Congress, Construction Machinery Outlook: Weekly Information Service Bulletin, December 8, 1944, p. 5.

⁵ Minerals Yearbook, 1943, Chapter on Fuel Briquets and Packaged Fuel, p. 1041.

Technologic developments.—Research in fuel briquetting in 1944 was confined mainly to experiments by the Bureau of Mines⁴ towards a broader utilization of Pennsylvania anthracite fines in combination with bituminous coal. Research of this kind was suggested by the Solid Fuels Administration for War to relieve shortages of bituminous coal for domestic use. The admixture of anthracite fines to bituminous coal has been used extensively in fuel briquetting but not in packaged fuel; these tests, however, show that such mixtures can be used successfully in packaged fuel.

One packaged-fuel and two fuel-briquet plants designed primarily for the utilization of anthracite fines are now nearing completion. The two briquet plants, to be operated by the Reading Briquet Co. at Locust Summit and St. Nicholas, Pa. (estimated construction cost approximately \$2,500,000), will have a combined annual capacity of 500,000 tons and plan to use an admixture of approximately 90 percent anthracite fines and 10 percent bituminous coal; production is expected to start in 1945.⁵ The packaged-fuel plant (estimated construction cost approximately \$400,000), to be operated by the White Glove Packaged Fuel Division of the Blaw-Knox Co., at Philadelphia, Pa.,⁶ utilizing a combination of approximately 80 percent Pennsylvania anthracite fines and 20 percent bituminous low-volatile coal, also expects to be in production in 1945. The three plants are Government-financed.

Investigations on briquetting various Illinois coals using the Piersol-designed press and process⁷ were continued in 1944 with special reference to contour of the briquet and the metallurgical composition of briquetting dies. Dies have been contoured to produce double rows of 1.2- by 1.5-inch notched ribbon briquets, 1.5-inch pillow briquets, and a single row of 3-inch pillow briquets and 3-inch semipillow briquets; of these, the last-named is considered the preferred contour.

Postwar outlook.—After the close of the war fuel-briquet production probably will continue high, and packaged fuel undoubtedly will recapture its former place in the fuel industry. This assumption is based upon the fact that past records for both these types of domestic fuel—generally high-grade in quality and of established popularity—show demand usually exceeding supply and the product sold as soon as available.⁸ Machine manufacturers report new and improved types of equipment and contracts for installations when War Production Board restrictions are lifted. Supplies of kraft paper used in packaging coal cubes probably will continue tight in 1945⁹ but will become available in larger quantities after the war.

⁴ Barkley, J. F., and Seymour, William, The War Problem of Increasing the Utilization of Small Anthracite: Paper presented at Semiannual Meeting, A. S. M. E., Pittsburgh, Pa., June 20, 1944, 11 pp. Solid Fuels Administration for War, P. N. 71018, SFA 254, September 5, 1944.

⁵ Seward's Journal, New Briquet Plants to be Permanent: Vol. 27, No. 37, December 16, 1944, p. VI; Ready to Build Briquet Plants: Vol. 27, No. 43, January 27, 1945, p. VI.

⁶ Black Diamond, New Packaged Fuel Plant at Philadelphia: Vol. 113, No. 12, December 9, 1944, p. 46.

⁷ Piersol, R. J., Briquetting Illinois Coals Without a Binder by Compression and Impact: Illinois State Geol. Survey Rept. of Investigations 31, 1933, 70 pp.; Briquetting Illinois Coals Without a Binder by Impact: Illinois State Geol. Survey Rept. of Investigations 37, 1935, 75 pp.; Smokeless Briquets: Impacted Without Binder from Partially Volatilized Illinois Coals: Illinois State Geol. Survey Rept. of Investigations 41, 1936, 30 pp.

⁸ Black Diamond, Chicago and Central Western Market—Twin Cities and Northwest: Vol. 112, No. 2, January 22, 1944, p. 52; vol. 112, No. 4, February 19, 1944, p. 60; vol. 112, No. 7, April 1, 1944, p. 44.

⁹ Neubrech, W. Leroy, Pulp and Paper Getting Scarcer: Domestic Commerce, vol. 33, No. 4, April 1945, p. 20.

The erection of the two Reading Briquet Co. plants and that of the White Glove Packaged Fuel Division of the Blaw-Knox Co. in Pennsylvania (to use Pennsylvania anthracite in combination with bituminous low-volatile) will extend the fuel-briquet and packaged-fuel markets still further.

FUEL BRIQUETS

Salient statistics of the fuel-briquetting industry from 1940 to 1944 are summarized in the following table. Production and value from 1917 to 1944, inclusive, are shown graphically in figure 1.

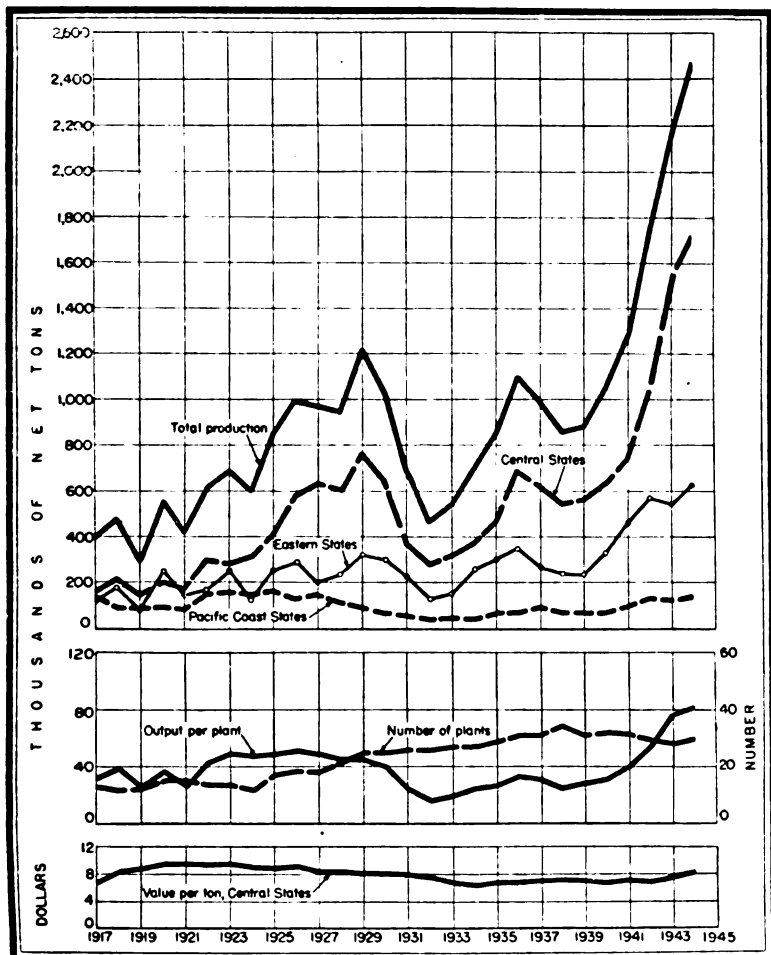


FIGURE 1.—Production of fuel briquets, output per plant, number of plants in operation, and average value per net ton, f. o. b. plant (Central States), 1917-44.

Salient statistics of the fuel-briquetting industry in the United States, 1940-44

[Data regarding packaged fuel are given separately at end of this chapter]

Year	Production				Im-ports	Ex-ports	Con-sump-tion ¹	Value of pro-duction (thou-sands of dol-lars)	Plants in op-eration	Average out-put per plant (thou-sands of net tons)	Average value per net ton, f. o. b. plant		
	East-ern States	Central States	Pacific Coast States	Total							East-ern States	Central States	Pacific Coast States
	Thousands of net tons												
1940.....	331	652	68	1,051	---	23	1,028	6,439	32	33	\$3.95	\$6.95	\$8.94
1941.....	458	752	89	1,299	(²)	40	1,259	8,062	32	41	4.21	7.09	8.36
1942.....	565	1,048	135	1,748	(²)	104	1,644	11,266	36	58	4.56	7.04	9.69
1943.....	545	1,493	122	2,164	(²)	175	1,989	15,148	28	77	5.04	7.44	10.28
1944.....	626	1,704	135	2,465	(²)	164	2,301	18,435	36	82	5.42	8.03	10.07

¹ Production plus imports minus exports.² Less than 1,000 tons.

Production.—The output of fuel briquets advanced in 1944 to a new high—2,464,961 tons valued at \$18,434,579—a 14-percent increase in tonnage and a 22-percent increase in value over 1943. The industry responded remarkably in its efforts to meet increased fuel demands notwithstanding the shortages of manpower and raw fuels and the staying hand of priorities on new equipment.

Production rose to 71 percent of the capacity of the 30 plants active in 1944, reported as approximately 3,494,000 tons (see capacity analysis in following pages). Briquets were produced in 15 States in 1944, with Wisconsin again leading and West Virginia, Missouri, and Pennsylvania following in order. (Wisconsin also led in packaged-fuel production in 1944.) All States except two showed increases over 1943, with Pennsylvania and Missouri outstanding. Fuel briquets have been produced in Missouri every year since 1907, but production was comparatively small until 1942. Output for the 13 States (other than Wisconsin and Missouri) cannot be shown separately without revealing data for individual plants.

Production of fuel briquets in the United States, 1943-44

	1943			1944			Percent of increase over 1943 in—	
	Plants	Net tons	Value	Plants	Net tons	Value	Tonnage	Value
Eastern States.....	4	544,786	\$2,746,109	5	625,779	\$3,393,595	14.9	23.6
Central States.....	21	1,493,368	11,110,885	22	1,704,005	13,680,036	14.1	23.1
Pacific Coast States..	3	125,844	1,291,115	3	135,177	1,360,948	7.4	5.4
	¹ 28	2,163,998	15,148,109	¹ 30	2,464,961	18,434,579	13.9	21.7

¹ 1943: 10 plants in Wisconsin; 3 in Missouri; 2 each in Illinois, Michigan, and West Virginia; and 1 each in Arkansas, California, Massachusetts, Minnesota, Nebraska, North Dakota, Oregon, Pennsylvania, and Washington; 1944: 10 plants in Wisconsin; 3 in Missouri; 2 each in Illinois, Michigan, Pennsylvania, and West Virginia; and 1 each in Arkansas, California, Massachusetts, Minnesota, Nebraska, North Dakota, Oregon, Washington, and Wyoming.

Production of fuel briquets in Wisconsin, 1939-44

Year	Plants	Net tons	Value	Year	Plants	Net tons	Value
1939.....	10	430, 554	\$3, 158, 859	1942.....	10	750, 417	\$5, 498, 748
1940.....	11	487, 574	3, 440, 676	1943.....	10	1, 070, 857	8, 228, 671
1941.....	10	535, 457	3, 870, 077	1944.....	10	1, 208, 147	10, 074, 861

Production of fuel briquets in Missouri, 1942-44

Year	Plants	Net tons	Value
1942.....	3	104, 415	\$589, 466
1943.....	3	188, 736	1, 236, 829
1944.....	3	252, 286	1, 910, 384

Bagging of bulk briquets at the plants, reported by seven operators in 1944, is a merchandizing feature only, used for convenience and cleanliness in the delivery of the fuel; one operator, however, reported wrapping several hundred tons of cubes—a small part of his total production—in 10-pound packages suitable for burning in the package if desired.

As briquets are used almost entirely for domestic space heating in the United States, production is normally highly seasonal; but in 1944, as in 1943, the monthly output continued fairly constant throughout the year. Of the 30 plants active in 1944, 24 operated every month and only 3 less than 10 months. According to the Weather Bureau,¹⁰ the coldest weather in 1944 in the briquet-consuming States occurred in January, in the Dakotas, Minnesota, Iowa, and Wisconsin, and is reflected in greatly increased shipments¹¹ of briquets to these States. A relatively mild winter was experienced in other parts of the country.

Monthly production of fuel briquets in the United States, 1942-44, in net tons

Month	1942	1943	1944	Month	1942	1943	1944
January.....	170, 991	187, 201	202, 234	August.....	112, 434	204, 424	222, 081
February.....	122, 083	192, 201	205, 879	September.....	139, 699	205, 979	222, 223
March.....	93, 668	188, 500	181, 137	October.....	204, 665	205, 118	239, 687
April.....	102, 514	133, 531	152, 725	November.....	177, 838	179, 564	240, 925
May.....	145, 792	121, 027	192, 944	December.....	197, 982	204, 299	253, 667
June.....	146, 389	183, 854	192, 427				
July.....	134, 145	188, 300	179, 032		1, 748, 300	2, 163, 998	2, 464, 961

Value.—The trend of fuel-briquet prices in the past 5 years is indicated best in this review by the average values in the Eastern, Central, and Pacific Coast States, as shown in the last three columns of the first table of this report. These are the values received by producers for the total product (exclusive of delivery charges) and not the prices paid by consumers; retail prices in certain cities are shown in a separate table.

¹⁰ Baldwin, J. L., *The Weather of the United States: U. S. Dept. of Commerce Monthly Weather Review*, vol. 73, January 1945, p. 6.

¹¹ See following table for "Shipments of fuel briquets of domestic manufacture, 1943-44, by States of destination, as reported by producers, in net tons."

The total value of fuel briquets produced in 1944 was \$18,434,579, f. o. b. plant—an increase of \$3,286,470, or 21.7 percent, over 1943.

Prices.—The following monthly fuel-briquet prices, available for 15 cities for 1944, except as otherwise indicated, represent cash sales to household customers for 1-ton lots (2,000 pounds) delivered at the curb or into the bin if no extra charge is made. The monthly periods covered extend from the 15th of one month to the 15th of the succeeding month. The changes in prices during the year are few and generally reflect local adjustment to ceilings allowed by OPA, based upon variations in costs.

Retail fuel-briquet prices per net ton in 1944, by cities and months

[Source: Bureau of Labor Statistics, U. S. Department of Labor]

City	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Baltimore, Md.	\$11.34	\$11.34	\$11.34	\$11.34	\$11.34	\$11.34	\$11.34	\$11.34	\$11.34	\$11.34	\$11.34	\$11.34
Boston, Mass.	14.34	14.34	14.34	14.34	14.34	14.34	14.34	14.34	14.34	14.34	14.34	14.34
Charleston, S. C.	14.25	14.25	14.25	14.25	14.25	14.25	14.25	14.25	14.25	14.25	14.25	14.25
Chicago, Ill.	12.97	12.97	12.97	12.97	12.97	12.97	12.97	12.97	12.97	12.97	12.97	12.97
Cincinnati, Ohio ¹	10.05	10.05	10.05	10.07	10.07	10.07	10.07	10.07	10.07	10.07	10.07	10.07
Columbus, Ohio ¹	10.14	10.14	10.42	10.42	10.42	10.42	10.42	10.42	10.42	10.42	10.42	10.42
Fall River, Mass.	14.33	14.33	14.34	14.35	14.35	14.35	14.35	14.35	14.35	14.35	14.35	14.35
Kansas City, Mo. ¹	11.47	11.47	11.49	11.49	11.49	11.49	11.49	11.49	12.01	12.01	12.01	12.01
Louisville, Ky.	9.36	9.36	9.48	9.48	9.48	9.48	9.48	9.48	9.48	9.48	9.48	9.48
Milwaukee, Wis.	12.56	12.56	12.56	12.56	12.78	12.78	12.78	12.78	12.78	12.78	12.78	12.88
Minneapolis, Minn.	14.09	14.09	14.09	14.09	14.32	14.35	14.35	14.35	14.35	14.35	14.35	14.35
Norfolk, Va.	12.00	12.00	12.00	12.00	12.15	12.15	12.15	12.15	12.15	12.15	12.15	12.15
St. Louis, Mo. ¹	11.76	11.76	11.76	11.76	11.76	11.76	11.76	11.76	11.76	11.76	11.76	11.76
St. Paul, Minn.	14.09	14.09	14.09	14.09	14.34	14.34	14.34	14.34	14.34	14.34	14.34	14.34
Washington, D. C. ¹	12.24	12.48	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24

¹ Includes 2 percent sales tax.

¹ Includes 3 percent sales tax.

¹ Price per gross ton (2,240 pounds).

Number of plants.—Thirty briquetting plants reported production in 1944, and all but two of these were active also in 1943. One plant, idle in 1943, resumed production late in 1944, and one plant, the Ecco Manufacturing Co., Pine Grove, Pa., started operating in January 1944. The Great Lakes Carbon Corp. discontinued briquetting operations at its St. Paul, Minn., plant in May 1944. The plants of the Scranton Collieries Corp. at Scranton, N. Dak., and of the Calkins Pressed Fuel Co., at Renton, Wash., have been permanently abandoned; the Scranton plant had been idle for many years, but the Renton plant was active from 1934 to 1942. Four plants were idle in 1944—one each in Connecticut and Minnesota, idle for 5 years or more, and one each in Ohio and Texas, idle since 1941, when a small production was reported.

Of the five plants reported under construction in 1943, only the Ecco Manufacturing Co., at Pine Grove, Pa., started production in 1944; one in Texas was idle in 1944, and construction on the other three is not yet complete.

Seven plants reported under construction in 1944 are as follows:

Briquetting plants reported under construction in 1944

Location of plant	Operator	Remarks
California, near King City.....	Chemt-Coal Products Co.....	Expects to start April 1945.
Illinois, at Belleville.....	Super Heat Fuel Co. ¹	Expects to start February 1945.
New York, at Elmira.....	Elmira Coal Co. ¹	Labor shortage delaying start of operations.
North Dakota, at Minot.....	Western Carbon & Chemical, Inc. ¹	Not yet operating commercially.
Pennsylvania— Near Locust Summit central breaker of anthracite-preparation plant of P. & B. C. & I. Co. (Post office: Locust Gap, Northumberland County).	Reading Briquet Co. ¹	Expects to start Spring 1945.
Near St. Nicholas central breaker of anthracite-preparation plant of P. & B. C. & I. Co. (Post office: Mahanoy City, Schuylkill County).	do ¹	Do.
Wisconsin, at Milwaukee.....	Virginia Coal & Supply Co.....	

¹ Also reported under construction in 1943.² Seward's Journal, New Briquet Plants to be Permanent: Vol. 27, No. 37, Dec. 16, 1944, p. VI; Ready to Build Briquet Plants: Vol. 27, No. 43, Jan. 27, 1945, p. VI.

Capacity of plants.—The following table gives comparative data for the past 8 years and reveals the greater utilization of the total capacity of the active briquetting plants—from 28.0 percent in 1938 to 70.6 percent in 1944. The 1944 production was close to three times that in 1938, with virtually stationary capacity in the interim. Eight plants, each of which produced over 100,000 tons in 1944, supplied 1,743,591 tons, or 70.7 percent of the total production, utilizing 70.5 percent of the combined capacity of this group. Twelve plants, each with an annual capacity of 100,000 tons or more, furnished 2,079,563 tons, or 84.4 percent of the total 1944 production, utilizing 71.9 percent of their combined capacity.

Annual capacity and production of active briquetting plants in the United States, 1937-44

	Active plants		Production		
	Number	Annual capacity (net tons)	Net tons	Percent of—	
				Annual capacity	Annual production
1937.....	31	3,423,000	995,930	29.1	100.0
1938.....	35	3,112,000	871,260	28.0	100.0
1939.....	31	3,161,000	892,213	28.2	100.0
1940.....	32	3,082,000	1,050,870	34.1	100.0
1941.....	32	3,100,000	1,298,606	41.9	100.0
1942.....	30	3,199,000	1,748,300	54.7	100.0
1943.....	28	3,164,000	2,163,998	68.4	100.0
1944:					
Capacity of—					
Less than 5,000 tons.....	1	15,000	4,100	27.4	.2
5,000 and less than 10,000.....	2				
10,000 and less than 25,000.....	6	89,500	50,727	56.7	2.0
25,000 and less than 100,000.....	9	495,500	330,562	66.7	13.4
100,000 and less than 200,000.....	7	883,900	774,130	87.6	31.4
200,000 and less than 400,000.....	2	2,010,000	1,305,433	64.9	53.0
400,000 or more.....	3				
	30	3,493,900	2,464,961	70.6	100.0
Production of—					
Less than 2,000 tons.....	13	63,000	9,446	15.0	.4
2,000 and less than 5,000.....	2				
5,000 and less than 10,000.....	3	38,000	21,557	59.9	.9
10,000 and less than 25,000.....	3	84,500	47,229	55.9	1.9
25,000 and less than 100,000.....	11	836,500	643,138	76.9	26.1
100,000 or more.....	8	2,473,900	1,743,591	70.5	70.7
	30	3,493,900	2,464,961	70.6	100.0

¹ 1 of these plants operated only 3 months of year.² 1 of these plants operated only 1 month of year.

The average output per plant rose from 58,000 tons in 1942 to 77,000 in 1943 and to 82,000 in 1944. Twenty-four plants operated every month in 1944 and produced 2,085,554 tons, or 85 percent of the total.

The largest capacities as well as largest productions in 1944 were reported by the Berwind Fuel Co. and the Stott Briquet Co. Inc., for their plants at Superior, Wis.

Raw fuels.—As shown in the following tables, seven kinds of raw fuels entered into the manufacture of fuel briquets in 1944, and 11 types of briquets were made from these fuels (either alone or in combination); the quantities of raw fuels used and tonnages of each type of briquets produced are shown wherever possible without revealing data on individual operations.

The notable increase in the use of Pennsylvania anthracite fines, both in the Eastern and Central States, particularly in combination with bituminous coal in 1944, is directly the result of the urging of the Solid Fuels Administration for War for wider utilization of the huge surplus of these anthracite fines to offset shortages in the bituminous supply. To assist the SFAW in its campaign for increased use of anthracite fines, OPA announced that briquet producers, who before November 23, 1943, used only bituminous coal, would not be required to reduce their maximum prices for briquets by the decrease in costs resulting from the substitution of anthracite for bituminous coal.¹²

There was also a large increase in the use of the hard coals of Arkansas in 1944, principally at briquetting plants in Arkansas, Minnesota, and Missouri.

Classification of plants and production of fuel briquets in the United States, by kinds of raw fuel used, 1942-44

Raw fuel used	1942			1943			1944		
	Plants	Briquets produced		Plants	Briquets produced		Plants	Briquets produced	
		Net tons	Per cent of total		Net tons	Per cent of total		Net tons	Per cent of total
Pennsylvania anthracite.....	1	591,068	33.8	1	845,882	39.1	2	1,409,312	57.2
Mixture of Pennsylvania anthracite and bituminous.....	4			5			10		
Semianthracite.....	4			4			5		
Mixture of Arkansas hard coals	1			1			1		
Mixture of semianthracite and bituminous.....	-----	126,331	7.2	1	235,865	10.9	-----	302,610	12.3
Mixture of semianthracite, bituminous, and petroleum coke.....	-----			1			1		
Bituminous:									
Low-volatile.....	14	832,292	47.6	14	932,582	43.1	10	584,981	23.7
High-volatile.....	2			1			1		
Semicoke (lignite char).....	1			1			1		
Residual carbon from pyrolysis of natural gas.....	1	170,799	9.8	1	149,669	6.9	1	161,910	6.6
Residual carbon from manufacture of oil gas.....	2			2			2		
Petroleum coke.....	6	27,810	1.6	-----	-----	-----	4	6,142	.2
	^a 36	1,748,300	100.0	^a 32	2,163,998	100.0	^a 38	2,464,961	100.0

¹ Relatively small tonnage of petroleum coke of a type exempt from wartime allocation in 1943.

² In 1942, 4 plants made 2 kinds and 2 plants made 3 kinds of briquets; in 1943, 4 plants made 2 kinds; in 1944, 6 plants made 2 kinds and 1 plant 3 kinds; hence the sum of these items exceeds the total number of plants active in the respective years.

¹² Seward's Journal, OPA Rules on Briquette Prices: Vol. 27, No. 8, May 27, 1944, p. 91.

Raw fuels used in making fuel briquets in the United States, 1942-44

Raw fuel	Net tons			Percent of total		
	1942	1943	1944	1942	1943	1944
Pennsylvania anthracite.....	269,558	388,693	711,109	16.3	18.7	30.5
Arkansas hard coals.....	117,389	203,357	272,242	7.1	9.8	11.7
Bituminous coals.....	1,077,474	1,341,013	1,188,886	65.2	64.6	51.0
Semicoke (lignite char).....	159,798	143,381	153,025	9.7	6.9	6.5
Residual carbon from pyrolysis of natural gas.....			6,224	1.7		.3
Residual carbon from manufacture of oil gas.....	27,409					
Petroleum coke.....						
	1,651,628	2,076,444	2,331,486	100.0	100.0	100.0

¹ Includes a relatively small tonnage of petroleum coke of a type exempt from wartime allocation in 1943.

Petroleum-coke briquets were again made in 1944, as wartime restrictions on its use as domestic fuel were rescinded on October 24, 1944.¹³

In the following table showing production with reference to supply of raw fuel, the greatest gain in output of briquets in 1944 over 1943 occurred at plants at or near coal mines, principally at plants in the Central States that obtain their raw fuel from hard-coal mines in Arkansas.

Production of fuel briquets, 1943-44, grouped according to location of plants with reference to supply of raw fuel

Location of plant	1943		1944		Change in 1944	
	Plants	Production (net tons)	Plants	Production (net tons)	Net tons	Percent
At or near Lake Superior, Lake Michigan, or Lake Huron coal docks:						
Lake Superior.....	4	691,407	4	819,674	+128,267	+18.6
Lake Michigan.....	7	443,376	7	442,950	-426	-.1
Lake Huron.....	1		1			
	12	1,134,783	12	1,262,624	+127,841	+11.3
At or near coal mines:						
Eastern States.....	3	544,671	4	625,427	+80,756	+14.8
Central States.....	6	320,492	6	401,436	+80,944	+25.3
	9	865,163	10	1,026,863	+161,700	+18.7
At or near petroleum refineries and oil- and natural-gas plants:						
Central States.....	1	153,354	1	166,701	+13,347	+8.7
Pacific Coast States.....	3		4			
	4	153,354	5	166,701	+13,347	+8.7
At other locations:						
Eastern States.....	1	10,698	1	8,773	-1,925	-18.0
Central States.....	2		2			
	3	10,698	3	8,773	-1,925	-18.0
Total United States.....	28	2,163,998	30	2,464,961	+300,963	+13.9

¹ Fall River, Mass., Jackson, Mich., and Omaha, Nebr.

¹³ Coal Dealer, War Production Board Freezes Stocks of Petroleum Coke: Vol. 39, No. 7, November 1942, p. 23. War Production Board Petroleum Coke Conservation Order M-212, March 1943. Black Diamond, Chicago and Central Western Market: Vol. 113, No. 9, October 28, 1944, p. 57.

Ten operators using anthracite and one using bituminous coal reported that the raw fuel is washed before it is manufactured into briquets.

Binders.—Asphalt binders remain the preferred type and were used by 24 plants that produced 84 percent of the fuel briquets made in 1944. Three plants used, respectively, asphaltic and coal-tar pitches combined, asphalt and starch combined, and starch. In 1944, as in 1942 and 1943, three plants used no binder; two of these briquetted the carbon residue from the manufacture of oil gas and one used low-volatile bituminous coal.

Approximately 144,000 tons of asphaltic types and small quantities of starch and coal-tar pitch were used as binders in 1944 in the manufacture of fuel briquets.

Seventy percent of the total production of fuel briquets in 1944 was made with binders ranging from 5 to 7 percent of the raw fuel used, as compared with 38 percent of the production in 1943 and 31 percent in 1942.

No operators reported recarbonization of the briquets after leaving the presses.

Classification of briquetting plants in the United States, 1942-44, by percentage of binder used

Ratio of binder to raw fuel (by weight)	1942			1943			1944		
	Plants	Production of fuel briquets		Plants	Production of fuel briquets		Plants	Production of fuel briquets	
		Net tons	Per- cent of total		Net tons	Per- cent of total		Net tons	Per- cent of total
Less than 5 percent.....	4	197,236	11.3	4	234,747	10.8	3	58,309	2.4
5 and less than 7 percent.....	12	548,834	31.4	13	829,953	38.4	17	1,734,549	70.4
7 and less than 9 percent.....	9	883,503	50.5	6	983,487	45.4	4	486,366	19.7
9 percent and over.....	2			2			3	61,993	2.5
No binder.....	13	118,727	6.8	13	115,811	5.4	13	123,744	5.0
	30	1,748,300	100.0	28	2,163,998	100.0	30	2,464,961	100.0

¹ 2 plants use residual carbon from manufacture of oil gas and 1 uses bituminous coal as raw fuel.

Weight and shape.—Pillow-shaped briquets (under 5 ounces, with one exception) made at 26 plants continue to be the most popular in the United States.

Prevailing weight of briquets produced in the United States in 1944

Weight (ounces)	Plants	Production		Weight (ounces)	Plants	Production	
		Net tons	Percent of total			Net tons	Percent of total
Less than 2.....	3	62,130	2.5	6 and under 10.....			
2 and under 3.....	13	1,333,007	54.1	10 and under 16.....	1		
3 and under 4.....	8	706,622	28.7	16 and under 26.....	2	110,279	4.4
4 and under 5.....	4	252,923	10.3				
5 and under 6.....					131	2,464,961	100.0

¹ 1 plant made briquets in both 2-ounce and 3-ounce weights, and 1 made cubes in 20- and 24-ounce weights; hence the sum of these items exceeds the total number of plants.

Shape of fuel briquets produced in the United States, 1943-44

Shape	1943			1944		
	Plants	Production		Plants	Production	
		Net tons	Percent of total		Net tons	Percent of total
Pillow.....	23	1, 668, 557	77. 1	26	1, 891, 804	76. 8
Cylindrical.....	3	495, 441	22. 9	3	573, 157	23. 2
Cube.....	2			2		
	28	2, 163, 998	100. 0	31	2, 464, 961	100. 0

¹ 1 plant made both pillow and cylindrical shapes; hence the sum of these items exceeds the total of the number of plants active in 1944.

Shipments.—The following table of shipments to States of destination indicates the wide use of fuel briquets in the United States. Produced in 15 States in 1944, they were shipped from 12 of these States of origin into 35 States and the District of Columbia, and were exported principally to Canada; the entire production of 3 of the smaller States was consumed within those States. Shipments within the United States in 1944 exceeded those of 1943 by 16 percent; more than half of the production was shipped direct to Minnesota, Wisconsin, North Dakota, Michigan, and South Dakota. The relatively small difference between production in 1944 (2,464,961 tons) and shipments within the United States (2,278,480 tons) represents briquets exported, used at plants for fuel, and stocks on hand at the beginning or end of 1944.

Shipments of fuel briquets of domestic manufacture, 1943-44, by States of destination, as reported by producers, in net tons¹

State	1943	1944	State	1943	1944
Arkansas.....	215	614	Nebraska.....	38, 693	44, 900
California.....	11, 093	12, 670	New Hampshire.....	2, 565	3, 336
Connecticut.....	1, 558	4, 512	New Jersey.....	2, 149	12, 193
Delaware.....	345	2, 751	New York.....	31, 158	48, 403
District of Columbia.....	644	872	North Carolina.....	12, 775	14, 383
Florida.....	444	484	North Dakota.....	94, 172	125, 331
Georgia.....	143	139	Ohio.....	53, 179	57, 226
Illinois.....	85, 174	90, 358	Oregon.....	82, 048	88, 107
Indiana.....	48, 071	49, 235	Pennsylvania.....	26, 784	45, 104
Iowa.....	61, 150	90, 379	Rhode Island.....	4, 502	6, 281
Kansas.....	12, 018	16, 595	South Carolina.....	3, 965	3, 800
Kentucky.....	3, 757	3, 477	South Dakota.....	84, 585	118, 811
Maine.....	6, 386	10, 358	Vermont.....	129	605
Maryland.....	3, 855	6, 649	Virginia.....	17, 518	19, 082
Massachusetts.....	37, 719	51, 075	Washington.....	15, 256	8, 266
Michigan.....	112, 335	121, 754	West Virginia.....	816	2, 307
Minnesota.....	487, 122	515, 671	Wisconsin.....	425, 258	448, 313
Missouri.....	202, 562	254, 360			
Montana.....		79			
				1, 970, 143	2, 278, 480

¹ Shipments include resales that might have been shipped to Canada or to other States of destination. For official export statistics see table "Briquets exported from the United States, 1943-44, by countries of destination and customs districts."

Shipments by States of origin cannot be shown, as there are only one or two plants in each producing State except Wisconsin and Missouri, and the individual operations would thus be revealed. However, the widespread distribution across State lines from centers of production to States of destination in 1928 and 1936 is shown graphically in Minerals Yearbook, 1937 (p. 965, fig. 65). In comparison with the data used as a basis for the 1936 graph, 1944 showed large increases in production of plants in Illinois, Michigan, and West

Virginia and extension of their markets to other States and to Canada. The comparison further shows Indiana, Colorado, and Texas eliminated in 1944 as producing States, and Idaho, Wyoming, Colorado, Tennessee, Texas, and Louisiana as receiving no shipments of briquets during that year; however, production and shipments for these States since 1936 have been small and intermittent.

Generally, rail shipments represent consumption at distant points, and shipments by truck show local and nearby consumption.

Direct shipments of fuel briquets by rail and truck, 1943-44, as reported by producers, in net tons¹

Produced in—	1943			1944		
	Rail	Truck ²	Total	Rail	Truck ²	Total
Eastern States.....	527, 476	16, 846	544, 322	606, 887	18, 216	625, 103
Central States.....	1, 193, 399	295, 647	1, 489, 046	1, 365, 356	331, 665	1, 697, 021
Pacific Coast States.....	22, 646	85, 751	108, 397	20, 737	88, 263	109, 000
Total United States.....	1, 743, 521	398, 244	2, 141, 765	1, 992, 980	438, 144	2, 431, 124

¹ Includes shipments outside the United States.

² Includes local deliveries.

³ In addition, 27,225 tons used as fuel at plants.

Imports and exports.—A small tonnage of fuel briquets was imported into the United States from Canada in 1944. Figures for imports of briquets since 1919, first year of record, are included in annual volumes of Mineral Resources and Minerals Yearbook.¹⁴ Virtually all exports¹⁵ of fuel briquets in 1944 were destined for Canada.

Briquets (coal and coke) and other composition coals for fuels imported for consumption in the United States, 1940-44

Year	Net tons	Value	Year	Net tons	Value
1940.....			1943.....	198	\$1, 151
1941.....	162	\$791	1944.....	538	3, 335
1942.....	334	1, 739			

Briquets (coal and coke) exported from the United States, 1943-44, by countries of destination and customs districts

COUNTRY	1943		1944		CUSTOMS DISTRICT—continued	1943		1944	
	Net tons	Value	Net tons	Value		Net tons	Value	Net tons	Value
Bolivia.....			28	\$957	Laredo.....			35	\$254
Canada.....	174, 774	\$1,364,199	163, 607	1,294,180	Maine and New Hampshire.....	43	\$246	88	502
Cuba.....	(1)	6			Michigan.....	96, 265	\$20, 927	97, 899	\$37, 706
Falkland Islands.....	22	560			New Orleans.....	22	660		
Liberia.....	2	26			New York.....	2	32	28	957
Mexico.....			37	282	Ohio.....	650	3, 213		
	174, 798	1, 364, 791	163, 672	1,295,419	Rochester.....			7, 461	33, 699
CUSTOMS DISTRICT					St. Lawrence.....	32, 481	211, 963	21, 691	172, 127
Arizona.....			1	16	San Diego.....			1	12
Buffalo.....	22, 356	133, 253	22, 818	133, 519	Washington.....			123	1, 235
Dakota.....	16, 175	130, 199	8, 895	77, 801		174, 798	1, 364, 791	163, 672	1,295,419
Duluth and Superior.....	6, 804	55, 398	4, 632	37, 591					

¹ Less than 1 ton.

¹⁴ 1919-29, Mineral Resources, 1929, pt. II, p. 32; 1930-35, Minerals Yearbook, 1936, p. 657; 1936, Minerals Yearbook, 1937, p. 964.

¹⁵ Beginning of export series in 1937, Minerals Yearbook, 1938, p. 803.

*World production.*¹⁶—Recent information on the production of briquets since 1938 in Germany—the world's largest briquet-producing country—shows the output in 1944 to have reached a total of 68 million metric tons, an increase of 33 percent over Germany's 1938 production and approximately 3 million tons more than the entire world's known production of briquets in that year. Data on production in other countries have been meager since the beginning of the war in 1939.

*World production of fuel briquets, 1938-44, by countries, in metric tons*¹

[Compiled by B. B. Waldbauer]

Country ¹	1938	1939	1940	1941	1942	1943	1944
Algeria.....	(?)	(?)	(?)	49,459	45,565	50,685	(?)
Australia: Victoria ²	420,704	421,254	(?)	440,718	420,086	421,619	(?)
Belgium.....	1,712,280	1,561,210	(?)	(?)	(?)	(?)	(?)
Bulgaria.....	85,770	83,496	100,000	(?)	(?)	(?)	(?)
Fire (Irish Free State).....	20,501	(?)	5,337	15,446	21,052	90,188	(?)
France.....	7,475,000	(?)	(?)	(?)	(?)	(?)	(?)
Germany:							
Coal.....	6,897,245	³ 6,950,000	³ 6,498,000	³ 7,855,000	³ 7,244,000	³ 7,185,000	³ 6,418,000
Lignite ⁴	44,007,298	³ 44,930,000	³ 48,853,000	³ 54,409,000	³ 55,293,000	³ 59,705,000	³ 61,549,000
Hungary.....	441,081	(?)	(?)	(?)	(?)	(?)	(?)
Indochina.....	131,558	185,400	114,000	(?)	(?)	(?)	(?)
Italy.....	51,047	83,052	(?)	(?)	(?)	(?)	(?)
Netherlands:							
Coal.....	1,262,716	1,268,926	(?)	(?)	(?)	(?)	(?)
Lignite.....	60,543	68,607	(?)	(?)	(?)	(?)	(?)
Netherlands Indies.....	82,123	85,079	99,315	(?)	(?)	(?)	(?)
New Zealand.....	29,947	29,889	28,529	20,220	13,052	12,386	(?)
Poland.....	222,531	(?)	(?)	(?)	(?)	(?)	(?)
Portugal.....	19,865	(?)	(?)	(?)	(?)	(?)	(?)
Rumania.....	232,662	(?)	(?)	(?)	(?)	(?)	(?)
Spain.....	668,000	789,815	820,479	412,453	788,612	653,994	(?)
Turkisk.....	86,478	83,989	48,678	24,259	20,091	(?)	(?)
Turkey.....	87,285	14,792	24,497	28,392	(?)	(?)	(?)
United Kingdom.....	937,415	813,810	(?)	(?)	(?)	749,342	(?)
United States ⁵	935,402	1,004,902	1,211,433	1,422,866	1,815,583	2,158,728	2,395,618
Yugoslavia.....	100,945	132,466	(?)	(?)	(?)	(?)	(?)
Total.....	⁷ 65,389,366	(?)	(?)	(?)	(?)	(?)	(?)

¹ In addition to countries listed briquets are produced in Canada, Czechoslovakia, and New Caledonia but data on output are not available.

² Data not available.

³ Data for year ended March 31 of year stated.

⁴ Beginning October 1939, figures include production from East Upper Silesia.

⁵ Beginning October 1938, figures include production from Sudetenland.

⁶ Includes packaged fuel as follows—1938: 146,012 tons; 1939: 195,504; 1940: 258,105; 1941: 244,797; 1942: 229,560; 1943: 195,592; 1944: 159,455 tons.

⁷ Total incomplete; it represents sum of figures given in table only.

PACKAGED FUEL

Packaged fuel is the trade name applied by the industry to a combination of briquetting and packaging of screenings compressed into 3- or 4-inch cubes and wrapped (six or eight in a package) in sturdy paper and sealed with gummed tape.

The phenomenal growth in popularity of packaged fuel from 1935 through 1940 and its decline since that time are strikingly illustrated in figure 2. The production of packaged fuel in 1944 continued its downward trend from 1940, when the industry was at its height with a production of 284,513 tons and 106 plants in operation. In 1944, as in previous war years, scarcity of labor and materials and restrictions on the manufacture of new equipment caused production to decline and closed many plants.

⁸ Data since 1913 published in earlier reports of this series.

The outstanding development in the packaged-fuel industry in 1944, and one that probably will revolutionize that field, is the plan sponsored by the Federal Government at the request of the Solid Fuels Administration for War¹⁷ to use Pennsylvania anthracite fines as raw fuel in packaged-fuel manufacture. The suggestion has proved feasible, as shown by extensive experiments by the Bureau of Mines,¹⁸ and such a packaged-fuel plant, now under construction in Philadelphia,¹⁹ is expected to be in production in 1945 by the White Glove Packaged Fuel Division of the Blaw-Knox Co. The plant will have an annual capacity of 150,000 tons and will use approximately 80 percent anthracite fines in combination with 20 percent bituminous low-volatile coal.

Processes.—No new presses or types of machinery were reported in use by the packaged-fuel industry in 1944. In 1944, 62 of the 68 operators used the Eberling process;²⁰ 2 operators used Leemon²¹ equipment; 2 used Glenn-Smith²² equipment; and the Johnson Coal Cubing Co., Inc.,²³ of Detroit, Mich., and one other plant used equipment designed by the latter company.

Salient statistics of the packaged-fuel industry from 1940 to 1944 are summarized in the following table.

Salient statistics of the packaged-fuel industry in the United States, 1940-44

[Data regarding fuel briquets are given separately at beginning of this chapter]

Year	Production (net tons)			Value of production	Plants in operation	Average output per plant (net tons)	Average value per net tons, f. o. b. plant	
	Eastern and Pacific Coast States	Central States	Total				Eastern and Pacific Coast States	Central States
1940.....	7,519	276,994	284,513	\$2,391,922	106	2,684	\$10.12	\$8.36
1941.....	9,549	260,295	269,844	2,471,567	103	2,620	10.95	9.09
1942.....	7,553	245,465	253,048	2,540,087	89	2,843	10.74	10.02
1943.....	4,970	210,635	215,605	2,866,733	72	2,995	11.15	10.96
1944.....	3,788	171,982	175,770	2,053,343	68	2,585	12.26	11.67

¹ Eastern States; no production in Pacific Coast States in 1943 and 1944.

Production and value.—The 68 plants active in 1944 produced 175,770 net tons with a value of \$2,053,343 (see fig. 2). Production decreased 18.5 percent from 1943 and total value decreased 13.2 percent; output declined in 9 of the 11 producing States. Michigan lost top rank in the industry to Wisconsin, principally as the result of the fire in July 1944 at the plant of the Johnson Coal Cubing Co., Inc., in Detroit, formerly the largest operator. (The plant, down for 4 months, has been rebuilt and operations were resumed in November 1944.) The

¹⁷ Solid Fuels Administration for War, P. N. 71018, SFA 254, September 5, 1944.

¹⁸ Barkley, J. F., and Seymour, William, The War Problem of Increasing the Utilization of Small Anthracite: Paper presented at Semiannual Meeting, A. S. M. E., Pittsburgh, Pa., June 20, 1944, 11 pp.

¹⁹ Black Diamond, New Packaged Fuel Plant at Philadelphia: Vol. 113, No. 12, December 9, 1944, p. 46.

²⁰ Coal Age, Packaged Fuel Sale Begun in Philadelphia: Vol. 50, No. 3, March 1945, p. 138.

²¹ Eberling, O. M., Packaged Fuel Produced by the Eberling Process: Coal Heat, vol. 28, No. 1, July 1935, pp. 64-66.

²² Black Diamond, vol. 102, No. 12, June 17, 1939, p. 15.

²³ Black Diamond, Briquetting Plant Solves Black Problem: Vol. 98, No. 6, March 13, 1937, p. 60. (Manufacturing and sales rights of briquetting machinery designed by Glenn Smith acquired in 1944 by Blaw-Knox Co., Philadelphia, Pa.)

²⁴ Black Diamond, A Mammoth Package Fuel Plant: Vol. 102, No. 7, April 8, 1939, p. 23.

Cleveland Cliffs Iron Co., at Green Bay, Wis., and the Coal Blox Co., at Minneapolis, Minn., rank as the largest individual producers in 1944.

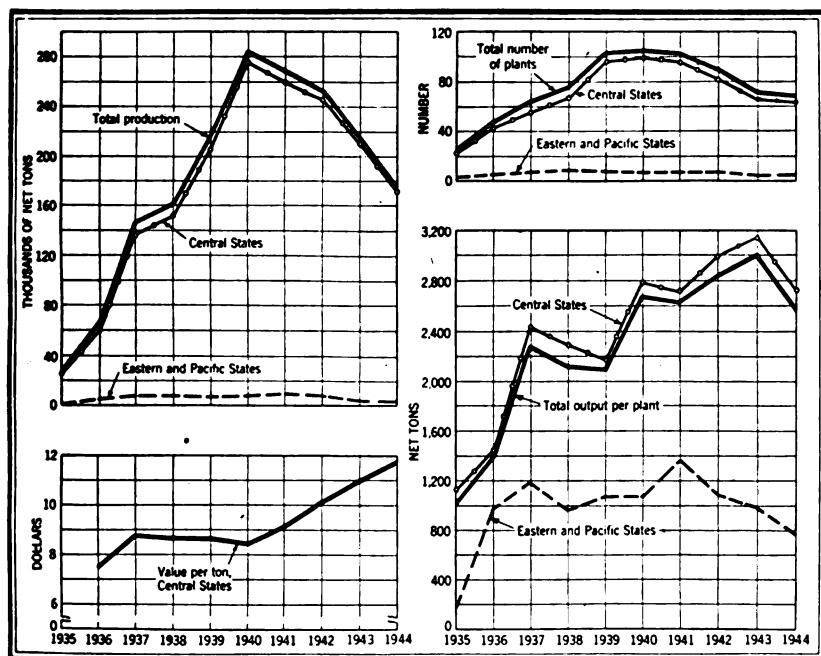


FIGURE 2.—Production of packaged fuel, average value per ton f. o. b. plant (Central States), number of plants in operation, and output per plant, 1935-44. (NOTE.—No production in Pacific Coast States, 1943-44.)

Production of packaged fuel in the United States, 1943-44, by States

[Plants and production not included in preceding fuel-briquet tables]

States	1943			1944		
	Plants	Net tons	Value	Plants	Net tons	Value
Central States:						
Illinois.....	4	3,081	\$38,445	4	1,637	\$23,037
Indiana.....	3	12,727	128,704	2	(¹)	(¹)
Iowa.....	1	(¹)	(¹)	1	(¹)	(¹)
Michigan.....	27	62,763	663,275	25	44,748	522,676
Minnesota.....	4	34,366	431,648	4	29,032	385,743
Missouri.....	2	(¹)	(¹)			
Nebraska.....	1	(¹)	(¹)	1	(¹)	(¹)
Ohio.....	16	33,341	363,153	16	31,423	342,399
Wisconsin.....	9	56,839	599,541	10	47,847	548,515
Undistributed ²		7,518	84,582		17,075	184,523
Total Central States.....	67	210,635	2,309,348	63	171,982	2,006,893
Eastern States.....	³ 5	4,970	57,385	³ 5	3,788	46,450
Total United States.....	72	215,605	2,366,733	68	175,770	2,053,343

¹ Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.

² Includes States entered as "(¹)" above.

³ Maine, 1; Pennsylvania, 1; and Virginia, 3.

The values, by States, represent the average per ton received by operators in 1943 and 1944 and show a general increase in average realization at the plant in 1944; advances were prevalent in all but two of the other producing States, but these cannot be shown because there were fewer than three operators in each of these States. The values do not represent the price per ton to the consumer, as many plants sell both to retailers and consumers, but rather the average per ton received by producers on the total product (exclusive of delivery charges). The value at the plant comprises cost of coal at the mine, freight rate, direct and indirect manufacturing costs, and profit.

Average value received per net ton of packaged fuel, 1943-44, by States ¹

State	1943	1944	State	1943	1944
Illinois.....	\$12.48	\$12.54	Ohio.....	\$10.89	\$10.90
Michigan.....	10.57	11.08	Virginia.....	11.27	11.18
Minnesota.....	12.55	13.28	Wisconsin.....	10.55	11.46

¹ Includes only those States where there were 3 or more plants in both years.

Thirty-one of the sixty-eight plants active in 1944 operated each month of the year and produced 75 percent of the total production; 31 operated 6 to 11 months, and 6 less than 6 months. Output during the year followed its usual seasonal pattern.

Monthly production of packaged fuel in the United States, 1942-44, in net tons

Month	1942	1943	1944	Month	1942	1943	1944
January.....	33,924	27,106	19,721	August.....	9,346	9,286	9,090
February.....	29,360	23,434	18,763	September.....	18,519	18,973	13,043
March.....	26,779	24,908	18,789	October.....	30,378	21,967	18,108
April.....	19,353	18,252	15,591	November.....	26,361	22,335	19,259
May.....	14,068	11,965	11,232	December.....	27,739	21,131	20,204
June.....	9,533	8,476	6,593				
July.....	7,688	7,772	5,377		253,048	215,605	175,770

Number of plants.—In 1944 the number of plants producing packaged fuel dropped to 68, the lowest since 1937, when there were 64 (the largest number was 106 plants in 1940). Sixty-three of these sixty-eight plants also were active in 1943, and over one-third of these are in the Detroit and Cleveland areas and contribute about 30 percent of the total production. Four additional plants equipped with used Eberling equipment began operating in 1944, and one plant under construction in 1943 went into production in January 1944. Twenty-two plants were idle in 1944 (8 of these were active in 1943); lack of labor and materials, scarcity of coal, and inability to operate without loss under OPA price ceilings were among the reasons given for idleness. Two companies reported plants under construction in 1944 (to start operations in April 1945)—a small plant in Detroit, Mich., and the large Government-sponsored plant of the White Glove Packaged Fuel Division of Blaw-Knox Co., at Philadelphia (discussed in the beginning of the packaged-fuel section of this report).

Activity in number of packaged-fuel plants in the United States, 1939-44

Year	Active	New	Idle	Out of business	Year	Active	New	Idle	Out of business
1939.....	103	29	11	9	1942.....	89	4	16	8
1940.....	106	16	15	14	1943.....	72	5	23	9
1941.....	103	7	8	14	1944.....	68	14	22	7

¹ All in Michigan and active in 1944.

² 11 in Michigan, 3 each in Indiana and Missouri, 2 each in Ohio and Wisconsin, and 1 in Washington.

³ 4 in Ohio and 1 each in Illinois, Maine, and Michigan; 1 of these was active in 1944 and 1943 and 6 were idle in 1943.

Capacity of plants.—The following table gives comparative data for the past 8 years and points out the large number of small plants in the packaged-fuel industry. In 1944 25 plants produced less than 1,000 tons each, contributing 8,655 tons, or 4.9 percent of the total production, and utilizing 14 percent of the combined capacity of this group. There were 45 plants, each with an annual capacity under 5,000 tons, that produced 48,040 tons, or 27.3 percent of the total production, and utilized 40 percent of their combined capacity.

Conversely, among the larger plants, four produced 62,095 tons—about one-third of the total 1944 production and two-thirds of their combined capacity.

Annual capacity and production of active packaged-fuel plants in the United States, 1937-44

	Active plants		Production		
	Number	Annual capacity (net tons)	Net tons	Percent of—	
				Annual capacity	Annual production
1937.....	64	456,000	146,037	32.0	100.0
1938.....	76	500,000	160,952	32.2	100.0
1939.....	103	700,000	215,507	30.8	100.0
1940.....	106	777,000	284,513	36.6	100.0
1941.....	103	698,000	269,844	38.7	100.0
1942.....	89	630,000	253,048	40.2	100.0
1943.....	72	460,000	215,605	46.9	100.0
1944:					
Capacity of—					
Less than 5,000 tons.....	¹ 45	120,200	48,040	40.0	27.3
5,000 and less than 10,000.....	12	66,900	27,943	41.8	15.9
10,000 and less than 15,000.....	6	67,000	31,016	46.3	17.7
15,000 and less than 25,000.....	3				
25,000 and less than 40,000.....	1				
40,000 and less than 60,000.....		174,500	68,771	39.4	39.1
60,000 tons or more.....	1				
	68	428,600	175,770	41.0	100.0
Production of—					
Less than 500 tons.....	¹ 18	41,000	4,434	10.8	2.5
500 and less than 1,000.....	7	21,700	4,221	19.5	2.4
1,000 and less than 3,000.....	28	109,300	50,780	46.5	28.9
3,000 and less than 5,000.....	8	59,100	31,760	53.7	18.1
5,000 and less than 10,000.....	3	105,600	22,480	21.3	12.8
10,000 and less than 25,000.....	3				
25,000 tons or more.....	1	92,000	62,095	67.5	35.3
	68	428,600	175,770	41.0	100.0

¹ 2 of these plants operated only few months late in year.

The average output per plant declined from approximately 3,000 tons in 1943 to 2,600 in 1944. Thirty-one plants (less than half of the plants active in 1944) operated every month throughout the year and produced 131,110 tons, or 75 percent of the total.

The largest capacity was reported by the Johnson Coal Cubing Co., Inc., Detroit, Mich., followed by the Cleveland Cliffs Iron Co., Green Bay, Wis.

Raw fuels.—Six kinds of raw fuels entered into the manufacture of packaged fuel in 1944. The use of bituminous slack decreased from 97 percent of the total raw fuels in 1943 to 90 percent in 1944. Packaged fuel made from petroleum coke—which in 1941 amounted to 18 percent of the total raw fuels used—is again appearing on the market, as wartime restrictions on its use as domestic fuel were rescinded on October 24, 1944.²⁴ A small tonnage of Pennsylvania anthracite in combination with bituminous slack was used by a packaged-fuel operator in Detroit, Mich.

The proposed utilization of over 100,000 tons of Pennsylvania anthracite fines²⁵ in the manufacture of packaged fuel in 1945 by the White Glove Packaged Fuel Division of Blaw-Knox Co. in Philadelphia will bring about changes in production centers and open new markets in the East.

Raw fuels used in making packaged fuel in the United States, 1942-44

Raw fuel	1942		1943		1944	
	Plants	Net tons	Plants	Net tons	Plants	Net tons
Bituminous:						
Low-volatile.....	79	210,761	69	206,059	65	156,388
High-volatile.....	4	4,655	2		3	316
Pennsylvania anthracite.....					1	
Semianthracite.....	2	34,969	2	6,613	2	17,157
Petroleum coke.....	11		12		7	
Coke breeze.....					1	
	96	250,385	75	212,672	79	173,861

¹ These plants reported a relatively small tonnage of petroleum coke of a type exempt from wartime allocation in 1943.

² In 1942, 5 plants made more than 1 kind and 2 used mixtures of these fuels; in 1943, 1 plant made 2 kinds and 2 plants used mixtures of these fuels; in 1944, 7 plants made 2 kinds and 4 plants used mixtures of these fuels. Hence the number of items exceeds the total number of active plants in the respective years.

Eight types of packaged fuel were made in 1944, as follows:

Classification of plants and production of packaged fuel in the United States in 1944, by kinds of raw fuel used

Raw fuel used	Plants	Packaged fuel produced	
		Net tons	Percent of total
Bituminous:			
Low-volatile (exclusively).....	61	151,626	86.3
High-volatile (exclusively).....	2		
Mixture of bituminous low- and high-volatile.....	1	12,265	7.0
Mixture of bituminous low-volatile and Pennsylvania anthracite.....	1		
Mixture of bituminous low-volatile and petroleum coke.....	1		
Mixture of bituminous low-volatile and coke breeze.....	1		
Semianthracite (exclusively).....	2	11,879	6.7
Petroleum coke (exclusively).....	6		
	75	175,770	100.0

¹ 7 plants made 2 types of packaged fuel; hence the sum of these items exceeds the total number of plants active in 1944.

²⁴ See footnote 13.

²⁵ See par. 3 of packaged-fuel section of this report.

In 1944, about 124,000 tons (71 percent of the total raw fuels) were shipped-in slack from the mines and from the Lake docks; the remainder represents yard screenings. Thirteen of the sixty-eight operators used shipped-in slack exclusively, 26 used yard screenings, and 29 used both shipped-in slack and yard screenings.

Cubes measuring 3 to 3½ inches were made at 51 packaged-fuel plants; 4-inch cubes were made at 20 plants, of which 3 made cubes in two sizes.

Of the 68 active plants, 23 reported wrapping the cubes by machine, 17 by hand, and 28 a combination of machine and hand. Sixty-two plants wrap 6 cubes to a package, 5 plants wrap 8 to a package, and only 1 reported a package of 4 cubes. Fifty plants make up packages weighing under 11 pounds, and 21 make packages of 11 to 16 pounds; of these, 3 plants make up packages of two weights.

Only one plant reported sales of packaged fuel in bulk (unwrapped), amounting to less than 25 tons.

Binders.—Cornstarches totaling 1,029 tons were used as binder by 66 plants, which produced 136,111 tons of packaged fuel, or 77 percent of the total production in 1944; of these, 13 reported using 10 to 14 pounds of starch binder per ton of raw fuel, 29 used 15 pounds per ton, 23 used 16 to 20 pounds, and 2 reported using over 20 pounds of binder per ton. Asphalt alone was used by two plants; and one plant making petroleum-coke cubes used a combination of starch and asphalt. No cement binder was used in 1944.

Classification of packaged-fuel plants in the United States, 1943-44, by type and percentage of binder used

Type of binder	Plants		Ratio of binder to raw fuel (by weight)	Plants	
	1943	1944		1943	1944
Starch.....	67	66	Less than 0.5 percent.....		
Starch and asphalt.....	1	1	0.5 and less than 1 percent.....	57	56
Asphalt.....	2	2	1 and less than 2 percent.....	11	11
Cement.....	3		2 and less than 3 percent.....	1	
			3 and less than 5 percent.....	2	
			5 percent and over.....	2	2
	173	169		173	169

¹ 1 plant made 2 kinds of cubes using starch binder for one and starch and asphalt for the other; hence the sum of these items exceeds the number of active plants.

Shipments.—Local sales (called for by passenger car or delivered by truck) accounted for 79 percent of the 1944 total sales; other than local (by truck to points in Wisconsin, Minnesota, and Michigan), 14 percent; and by rail (to points in Wisconsin, Michigan, and Minnesota), 7 percent.

Shipments of packaged fuel, by method of movement, 1942-44, in net tons

Year	Shipped by truck			Shipped by rail	Total
	Local sales ¹	Other than local sales	Total truck		
1942.....	220,063	22,203	242,266	10,944	253,210
1943.....	167,800	33,582	201,382	14,137	215,519
1944.....	139,026	24,302	163,328	12,389	175,717

¹ Includes sales called for and delivered.

PEAT

By J. A. CORGAN AND GOLDEN V. CHIRIACO

SUMMARY OUTLINE

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SUMMARY

According to reports received by the Bureau of Mines, 57,987 short tons of peat, valued at \$524,521, were produced in the United States in 1944. Although this figure represents a minor drop from the 1943 output of 60,002 short tons, valued at \$491,460, it remains slightly more than half the peak United States production of 107,261 short tons in 1918.

The continued shortage of manpower has been the principal factor in the steady decline in peat production since 1941, and operations at many of the peat bogs have been discontinued until after the war.

Imports of peat moss, curtailed sharply since 1940 on account of the war, totaled 64,428 short tons, valued at \$1,916,794 in 1944 compared with 59,427 tons, valued at \$1,577,388, in 1943. As no exports are reported, the quantity available for domestic consumption in 1944 amounted to 122,415 tons, a slight increase over the 119,429 tons available in 1943. Approximately 97 percent of the peat produced was used for soil improvement and in mixed fertilizers.

A directory of names and addresses of operators who reported 1944 production to the Bureau of Mines has been prepared and will be furnished, upon request, to those who may be interested.

Reserves.—Peat, an integral part of the natural resources of the country, is found in about half of the States. An estimate of 13,827,-000,000 tons has been calculated as air-dried peat.¹

Minnesota, Wisconsin, and Michigan combined contain 75 percent of the reserves; 14 percent of the country's total is in Florida; and the rest is distributed through the New England and Pacific Coast States.

PRODUCTION

The 1944 production of 57,987 short tons, reported to the Bureau of Mines by 35 producers operating in 17 States, is comparable with 60,002 tons produced in 1943 by 37 producers in 17 States. Many operators reported that production had dropped considerably because of their inability to procure sufficient labor; whereas others, forced to close their plants altogether because of the labor situation, reported that they expect to resume operations after the war.

¹ Soper, E. K., and Osbon, C. C., The Occurrence and Uses of Peat in the United States: Geol. Survey Bull. 728, 1922, p. 92.

The average value per ton in 1944 was \$9.05, an increase of 10.5 percent over the 1943 value of \$8.19. Production and value for 1939-44 are shown in the following table.

Peat produced in the United States, 1939-44

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per ton			Total	Average per ton
1939.....	55,483	\$362,066	\$6.53	1942.....	71,500	\$516,887	\$7.23
1940.....	70,097	516,865	7.37	1943.....	60,002	491,460	8.19
1941.....	86,503	657,556	7.60	1944.....	57,987	524,521	9.05

Figure 1 illustrates graphically the trend in production and value of peat from 1908 to 1926 and from 1934 to 1944. No data are available for 1927 to 1933, inclusive, as the Federal Government made no canvass of the peat industry for those years.

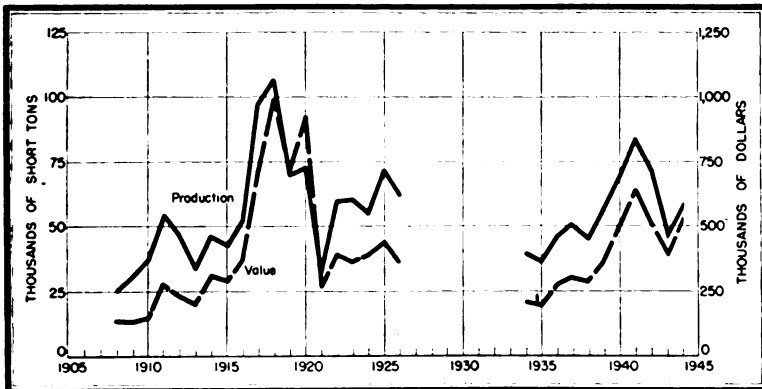


FIGURE 1.—Quantity and value of peat production in the United States, 1908-44; no data available for 1927-33.

In 1944 the producing States, in order of output, were New Jersey, Illinois, Michigan, Pennsylvania, California, Florida, New York, Iowa, Maine, Wisconsin, Texas, Minnesota, Ohio, Washington, Georgia, Massachusetts, and New Hampshire. In 1943 Illinois led and was followed by New Jersey, New York, and Pennsylvania, the position of the other States varying also from that in 1944.

Peat humus, produced in 12 States, comprised 54 percent of the total production; reed or sedge peat, produced in 9 States, 37 percent; and moss peat and other, produced in 6 States, 9 percent.

USES

Reports continued to indicate that most of the peat sold in this country is used for soil improvement. In 1944, 75 percent was sold for this purpose, 22 percent was used in mixed fertilizers, and 3 percent was sold for other uses, including litter for barns and poultry yards. Peat is used also as packing for fruits, vegetables, shrubs, and fragile articles. No sales of peat for fuel purposes were reported.

In some European countries peat is used extensively as fuel. In the United States, except for regional emergencies, it has not been used for this purpose on a commercial scale because of plentiful supplies of higher-grade fuels.

Moss peat was collected for surgical dressings during the World War of 1914-18, at which time 595,540² moss-peat pads were prepared in this country, under the direction of the American Red Cross, and used in military hospitals both here and in Europe. Most of the peat came from Maine, Washington, and Oregon. Peat has not been used for this purpose during the present war because of available facilities for making surgical dressings from cotton, of which the supply has been ample.

United States Government specifications.—The Federal Government purchases a certain amount of peat provided it meets the required specifications. These specifications may be obtained from the Procurement Division, United States Treasury Department, Washington, D. C.

IMPORTS³

Imports in 1944, all of which came from Canada, totaled 64,428 short tons, valued at \$1,916,794. Before 1939 most of the peat imported came from Germany. In 1938 Germany supplied 36,381 short tons, valued at \$525,564; in the same year, the Netherlands and Sweden together supplied 21,836 tons, valued at \$348,252. The opportunity for increasing output, presented to producers in the United States by the decline in imports from other countries, has been thwarted to a great extent because of difficulties in obtaining necessary labor and materials.

The average value per short ton of imported peat was \$29.75 in 1944, compared with \$26.54 in 1943.

Peat moss imported for consumption in the United States, 1939-44

Year	Short tons	Value	Year	Short tons	Value
1939.....	78,611	\$1,204,883	1942.....	49,236	\$1,219,473
1940.....	21,689	454,632	1943.....	59,427	1,577,388
1941.....	30,342	704,264	1944.....	64,428	1,916,794

Peat moss imported for consumption in the United States, 1943-44, by countries

Country	Poultry and stable grade				Fertilizer grade			
	1943		1944		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Canada.....	32,070	\$910,898	37,035	\$1,162,287	27,357	\$666,490	27,393	\$754,507
Total.....	32,070	910,898	37,035	1,162,287	27,357	666,490	27,393	754,507

² Hotson, J. W., *Sphagnum from Bog to Bandages*: Washington Univ. Puget Sound Biol. Sta. Pub., vol. 2, No. 47, 1919, pp. 213, 243.

³ Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

WORLD PRODUCTION

Restrictions imposed by wartime conditions have made it difficult to obtain data on production of peat in foreign countries. The latest available data are given in the following table.

World production of peat, 1939-44, by countries¹

[Compiled by B. B. Waldbauer]

Country ¹	1939	1940	1941	1942	1943	1944
Canada:						
Fuel.....metric tons..	(?) 404	27	322	156	709	566
Peat moss.....do.....	(?)	15,591	25,222	48,540	58,386	57,288
Denmark.....do.....	(?)	2,500,000	2,500,000	4,600,000	6,000,000	(?)
Eire ² do.....	2,392,591	3,624,250	5,398,274	4,312,738	4,954,895	(?)
Finland.....do.....	(?)	30,000	100,000	130,000	200,000	(?)
Iceland.....do.....	(?)	24,344	18,003	(?)	11,560	(?)
Latvia:						
Litter.....cubic meters..	80,000	(?)	(?)	(?)	(?)	(?)
Waste.....do.....	20,000	(?)	(?)	(?)	(?)	(?)
Insulation.....do.....	3,000	(?)	(?)	(?)	(?)	(?)
Lithuania.....metric tons..	230,000	(?)	(?)	(?)	(?)	(?)
Netherlands.....do.....	822,400	842,000	(?)	(?)	(?)	(?)
Norway.....do.....	(?)	(a)	127,000	185,000	(?)	(?)
Sweden:						
Fuel.....do.....	22,953	76,367	234,934	700,000	1,200,000	(?)
Litter, baled.....do.....	101,883	123,201	118,599	(?)	(?)	(?)
Litter and "mull," unbaled						
cubic meters.....	35,724	6,000	3,649	(?)	(?)	(?)
"mull," baled.....metric tons..	29,220	25,543	26,420	(?)	(?)	(?)
Switzerland.....do.....	15,000	12,000	40,000	200,000	430,000	310,000
United States.....do.....	50,333	63,591	78,474	64,863	54,433	52,605

¹ In addition to countries listed, Argentina, Austria, Estonia, France, Germany, Hungary, Italy, Poland, and U. S. S. R. produce peat, but data of production are not available.

² Data not available.

³ Estimate.

⁴ Figures rendered for 1942 and earlier years relate to production by holders of agricultural land only those for 1943 cover total production.

⁵ Fiscal year ended Apr. 30 of year stated.

NATURAL GAS¹

By F. S. LOTT AND H. BACKUS

SUMMARY OUTLINE

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SUMMARY

The marketed production of natural gas in 1944 is estimated to have increased 11 percent over 1943 to 3,780,232 million cubic feet, under the influence of a sustained high level of industrial production and record income payments. Domestic consumption was 10 percent, commercial consumption 9 percent, and total industrial 11 percent greater than in 1943.

The scarcity of other fuels, or more urgent demands for them, contributed to the volume of sales of natural gas, which was used as a substitute fuel in some localities. On the other hand, curtailment of industrial use was necessary in a few areas where capacity to deliver gas was unequal to peak load requirements during extremely cold weather. The major pipe-line systems undoubtedly operated at a higher percentage of their total annual capacity (load factor) in 1944 than in any previous year. Their major problems stemmed from the conflict between the growing demands of war-stimulated markets and restricted means with which to supply them.

Of the industrial uses, all expanded in 1944 except fuel at portland-cement plants, which contracted 31 percent owing to curtailment of cement production. Consumption at carbon-black plants increased sharply (17 percent) after 3 years of decline as the demand for carbon black mounted rapidly to record levels.

The average value of natural gas at the wells is estimated to have increased to 5.4 cents per thousand cubic feet in 1944 from 5.2 cents in 1943, extending the slow rise that began in 1941. Major production gains continued to center in the southwestern fields, where values are below the national average. However, the trend of values remains upward in virtually all producing districts.

¹ In this report the term "billion" is equivalent to 1,000,000,000 and "trillion" to 1,000,000,000,000, according to United States usage.

The indicated value at points of consumption of all gas marketed in 1944 is estimated to have declined to 21.8 cents per thousand cubic feet from 22.3 cents in 1943. Domestic and commercial average values continued the decline which since 1938 has amounted to about 8 percent and 15 percent, respectively. In the same period average consumption per domestic meter increased 28 percent to 54,900 cubic feet in 1944, and consumption per commercial meter increased 60 percent to 263,500 cubic feet. The average value of miscellaneous industrial gas (excluding field and carbon black) was only about 2 percent less in 1944 than in 1938, but the average use per consumer gained 94 percent to about 41.2 million cubic feet.

Salient statistics of natural gas in the United States, 1940-44

	1940	1941	1942	1943	1944 ¹
Marketed production:					
California..... millions of cubic feet...	351,950	374,905	403,968	457,757	530,000
Louisiana..... do.....	343,191	403,855	447,686	505,294	615,000
Oklahoma..... do.....	257,626	234,054	269,704	285,045	315,000
Texas..... do.....	1,063,538	1,086,312	1,170,345	1,323,885	1,460,000
West Virginia..... do.....	188,751	207,681	215,193	223,787	200,000
Other States..... do.....	455,166	505,851	546,579	618,921	660,232
Total production..... do.....	2,660,222	2,812,658	3,053,475	3,414,689	3,780,232
Exports to—					
Canada..... do.....	90	121	130	131	125
Mexico..... do.....	5,473	7,345	8,572	11,079	13,900
Consumption:					
Domestic..... do.....	443,646	442,067	498,537	529,444	582,000
Commercial..... do.....	134,644	144,844	183,603	204,793	224,000
Industrial:					
Field..... do.....	711,861	686,158	721,063	780,986	860,000
Carbon-black plants..... do.....	368,802	365,377	335,533	315,562	370,000
Petroleum refineries..... do.....	128,007	148,127	201,670	243,584	280,000
Portland-cement plants ² do.....	41,949	54,208	64,540	51,748	35,588
Other industrial..... do.....	825,750	964,411	1,039,827	1,277,362	1,414,619
Total consumption..... do.....	2,654,659	2,805,192	3,044,773	3,403,479	3,766,207
Electric public-utility power plants³					
..... millions of cubic feet...	183,156	205,156	238,736	305,576	359,776
Domestic..... percent of total.....	17	16	16	16	15
Commercial..... do.....	5	5	6	6	6
Industrial..... do.....	78	79	78	78	79
Number of consumers:					
Domestic..... thousands.....	9,245	9,730	10,135	10,354	10,600
Commercial..... do.....	741	767	779	811	850
Industrial ⁴ do.....	41	43	41	42	42
Number of producing gas wells	53,880	55,500	56,150	57,200	(⁵)
Value (at wells) of gas produced:					
Total..... thousands of dollars.....	120,493	138,508	154,236	176,893	204,133
Average per M cubic feet..... cents.....	4.5	4.9	5.1	5.2	5.4
Value (at points of consumption) of gas consumed:					
Domestic..... thousands of dollars.....	315,515	318,093	352,520	370,558	398,670
Commercial..... do.....	64,399	68,398	80,189	87,648	94,080
Industrial..... do.....	197,090	233,547	258,458	300,731	328,560
Total value..... do.....	577,004	620,038	691,167	758,937	821,310
Average per M cubic feet:					
Domestic..... cents.....	71.1	72.0	70.7	70.0	68.5
Commercial..... do.....	47.8	47.2	43.7	42.8	42.0
Industrial..... do.....	9.5	10.5	10.9	11.3	11.1
Domestic and commercial..... do.....	65.7	65.9	63.4	62.4	61.1
Domestic, commercial, and industrial..... cents.....	21.7	22.1	22.7	22.3	21.8
Treated for natural gasoline:					
Quantity..... millions of cubic feet.....	2,471,400	2,763,300	2,864,400	3,028,000	3,300,000
Ratio to total consumption.....	93	99	94	89	88

¹ Subject to revision.

² Chapters on Cement in Minerals Yearbook.

³ Federal Power Commission: Figures include gas other than natural, impossible to segregate; therefore shown separately from main table.

⁴ Exclusive of oil- and gas-field operators.

⁵ Figures not yet available.

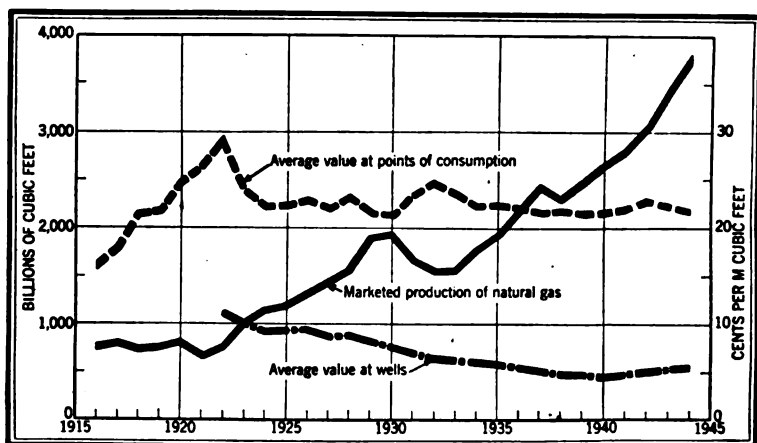


FIGURE 1.—Production and value of natural gas in the United States, 1916-44.

The total value of marketed production at the wells has increased 80 percent since 1938 to about \$204,133,000 in 1944, and the total at points of consumption has gained 64 percent to \$821,310,000.

Exports to Mexico, which have grown in each year since 1938, reached a new record of about 13,900 million cubic feet in 1944. An application to construct a new line from South Texas to Monterrey, Mexico, was rejected by the Federal Power Commission early in 1945.

The number of consumers of natural gas of all types except oil- and gas-field users and carbon-black manufacturers amounted to about 11,492,000 in 1944, or 3 percent more than in 1943.

LAW AND ADMINISTRATION

Expanding requirements for war production, with the attendant problems of fuel supply and transportation, placed a heavy load upon the gas utilities in 1944. A limited control of gas distribution was exercised by Government action to protect essential users during the period of greatest demand.

The Office of War Utilities ordered 60 natural-gas companies that obtain gas from the Panhandle Eastern Pipe Line Co. to stop deliveries between February 15 and March 15, 1944, to all consumers having facilities for using fuels other than natural or liquefied petroleum gas. The order affected companies operating in Missouri, Michigan, Illinois, Indiana, Ohio, and Kentucky. The gas thus released was diverted to improve the supply for eastern market areas where war industries were facing curtailment or shut-down for lack of fuel. It has been estimated that restrictive measures reduced industrial use of natural gas about 15 billion cubic feet in the Appalachian area below the volume that would have been consumed, had it been available.

The gas shortage in that region prompted the Federal Power Commission to grant certificates for the construction of the Tennessee Gas & Transmission Co. line from South Texas to West Virginia and the War Production Board to allocate the necessary critical materials as a war measure.

On September 22, 1944, the Federal Power Commission made known its intention to investigate the conservation and utilization of natural gas, involving a study of the extent of reserves, types of use, competition with other fuels, and related matters.

The announcement produced a vigorous reaction from officials of producing States (particularly in the Southwest), from the gas industry, and from the petroleum industry, which was involved because of the close association of natural gas with petroleum production. Widespread discussion of the problems relating to gas conservation followed among these groups and in the public press. In response to the invitation of the Federal Power Commission to the States and other interested parties to file statements of their views and relevant statistical studies, several States and a number of industry groups began to prepare material for presentation at public hearings scheduled for late in 1945 at convenient points in gas-producing States.

Renewed interest in State laws applicable to oil and gas production was indicated by the introduction of numerous bills in the legislatures of important producing States, accompanied by debate of controversial issues and analysis of existing laws directed particularly toward an appraisal of those clauses bearing upon operating practices in the production of gas. A decision of the Supreme Court of Texas affirmed the power of the Railroad Commission to enforce the ratable taking of gas from wells and to adjust correlative rights of producers.

GROSS PRODUCTION

The gross production of natural gas in 1943 is estimated to have increased 11 percent over 1942 to 4,942,560 million cubic feet. Gains were indicated in most producing States, led by Texas, California, and Louisiana. As in 1942, the only large decline in output occurred in Illinois, where a high percentage of the gas is produced with oil and is not marketed.

The production from gas and condensate wells was about 3,208,780 million cubic feet in 1943 or 11 percent greater than in 1942. Of this total, Texas contributed 51 percent, Louisiana 16, West Virginia 7, Oklahoma 5, and California 5.

Available evidence indicates that the volume of gas produced from oil wells increased to 1,733,780 million cubic feet in 1943 from 1,568,810 million in 1942, influenced primarily by a 9 percent gain in oil production. Accurate records of the gas produced with oil are generally kept only for those areas in which close control of reservoir performance is maintained or to cover that portion of the gas which is utilized for purposes other than the production of oil. Therefore, the statistics of this type of gas production are incomplete. A comprehensive study of gas : oil ratios could be used to closely approximate the rate of production of gas from oil wells. Such a study is under consideration in Texas.

Gross production and disposition of natural gas in the United States, 1942-43, by States, in millions of cubic feet

State	Estimated production ¹			Estimated disposition			
	From gas wells	From oil wells	Total	Marketed production	Repressuring	Stored in ground	Losses and waste ²
1942							
Arkansas.....	19,000	30,000	49,000	19,456	7,943	489	21,112
California.....	104,900	367,700	472,600	403,968	42,162	6,827	19,643
Colorado.....	4,700	400	5,100	4,866			235
Illinois.....	1,500	85,000	86,500	14,484	2,258	1,038	68,720
Indiana.....	1,200	2,490	3,690	1,699	219		1,872
Kansas.....	77,000	46,000	123,000	112,921	3,749	1,596	7,558
Kentucky.....	78,000	9,700	87,700	80,089	559		6,851
Louisiana.....	463,700	205,400	669,100	447,686	79,921		141,493
Michigan.....	13,400	4,500	17,900	15,821		2,081	298
Mississippi.....	1,500	2,300	3,800	2,062			1,718
Missouri.....	100	10	110	100			10
Montana.....	29,900	1,600	31,500	31,475	10		15
New Mexico.....	37,900	116,900	154,800	78,164	1,288		75,348
New York.....	10,700	100	10,800	8,718		1,057	1,792
Ohio.....	49,100	5,400	54,500	45,055	3,324	2,732	5,227
Oklahoma.....	135,900	167,000	302,600	269,704	13,457	25	18,964
Pennsylvania.....	99,400	5,500	104,900	93,532	997	3,054	8,192
Texas.....	1,508,800	482,100	1,990,900	1,170,345	579,237	1,318	239,606
West Virginia.....	219,500	12,000	231,500	215,193	5,005	807	8,216
Wyoming.....	23,800	22,700	46,500	33,124	12,490		886
Other States ³	5,390	10	5,400	5,394			6
	2,885,090	1,568,810	4,453,900	3,053,475	752,619	21,024	626,782
1943							
Arkansas.....	29,000	30,000	59,000	36,469	8,775	98	13,658
California.....	155,000	400,000	555,000	457,757	73,275	6,113	17,855
Colorado.....	6,000	1,000	7,000	6,445	273		282
Illinois.....	1,300	62,700	64,000	18,120	5,866	905	39,109
Indiana.....	1,100	1,300	2,400	1,450	499		451
Kansas.....	98,000	52,000	150,000	133,729	2,069	1,325	13,513
Kentucky.....	92,000	10,000	102,000	92,364	625		8,971
Louisiana.....	515,000	185,000	700,000	505,294	91,144	58	103,504
Michigan.....	21,900	1,700	23,000	18,006		3,226	1,768
Mississippi.....	1,350	1,450	2,800	1,461			1,339
Missouri.....	130	10	140	124			16
Montana.....	30,500	1,500	32,000	31,562	35		403
New Mexico.....	41,000	125,000	166,000	86,500	3,204		76,296
New York.....	9,300	100	9,400	8,062		639	1,163
Ohio.....	58,500	4,500	63,000	52,001	3,495	1,608	7,184
Oklahoma.....	161,000	163,000	324,000	285,046	14,020	1,113	23,471
Pennsylvania.....	97,500	5,500	103,000	93,543	1,335	708	7,068
Texas.....	1,630,000	650,000	2,280,000	1,323,885	600,773	1,327	353,700
West Virginia.....	232,000	11,000	243,000	223,787	5,428	45	12,734
Wyoming.....	24,000	28,000	52,000	34,351	13,957	1,788	1,904
Other States ³	4,800	20	4,820	4,734			86
	3,208,780	1,733,780	4,942,560	3,414,689	824,803	18,953	684,115

¹ Marketed production plus quantities used in repressuring, stored in ground, lost, and wasted (see footnote 2).

² Includes gas (mostly residue gas) blown to the air and transportation losses but does not include direct waste on producing properties, except where data are available.

³ Revised figures.

⁴ Includes gas transported from other States.

⁵ North Dakota, South Dakota, Tennessee, Utah, and Virginia.

In 1943 repressuring or pressure-maintenance with natural gas was reported in 16 States, an addition of one (Colorado) to the 1942 list. A significant increase in California resulted from greater efforts to conserve oil-field gas for use in oil production and for growing markets that threaten to outstrip present sources of supply in the southern district. Further gains in Texas and Louisiana were related primarily to expansion of cycle-plant operations in condensate-type fields. In the oil fields of most other States (particularly in Illinois and New Mexico) moderate growth in gas injection operations was indicated.

The total volume of gas returned for repressuring in 1943 was 824,803 million cubic feet, 10 percent more than in 1942 and the largest quantity so used in any year.

The storage of natural gas in depleted natural reservoirs for delayed marketing was reported in 13 States in 1943, 2 more than in 1942. The total quantity of gas stored, however, declined to 18,953 million cubic feet from 21,024 million in 1942. Smaller net amounts of gas were stored in several Western States and in all of the States in the critical Appalachian region. These declines do not indicate that the magnitude and importance of the functions of gas storage in marketing operations have lessened. Most reservoirs equipped for storage were filled to, or near, desired operating pressures in prior years. Heavy withdrawals of gas in the cold months of 1943, particularly in November and December, reduced the net gain in volume of gas in storage to a small percentage of the total input during the summer months.

Information from the Office of War Utilities indicates that in the Appalachian region the total quantity of natural gas in storage and available to meet peak-load demands reached a new high of 65.7 billion cubic feet on September 30, 1944, or 2.3 billion cubic feet above the seasonal peak of 1943. A total of 26.7 billion cubic feet of natural gas was added to storage during the summer of 1944, and withdrawals during the calendar year amounted to 24.5 billion. Deliveries of gas from fields in the Southwestern States were of value to the storage program in this area. Such deliveries increased from about 8 billion cubic feet in 1943 to 41 billion in 1944.

The estimated amount of gas lost and wasted (684,115 million cubic feet) in 1943 was about 9 percent above the 1942 total, primarily because of operations in Texas, where both oil production and gas marketing increased materially. The waste in Illinois was reduced 43 percent in 1943 with the further decline in flush oil-producing capacity. In Arkansas and California steps were taken to utilize more of the available gas or to return it to productive formations below ground.

MARKETED PRODUCTION

The quantity of natural gas marketed reached a new peak in 1943, conforming to the trends of industrial production and national income. Under the wartime economy the demand for natural gas has increased so rapidly in many industrial areas that total sales have been limited during winter months by transmission capacity rather than by the desire of consumers to buy.

A total of 3,414,689 million cubic feet was marketed during the year—12 percent over the 3,053,475 million recorded in 1942. Increased production was reported in all States except Indiana, Mississippi, New York, South Dakota, Utah, and Virginia, none of which has a large output. New York produced less than one-fourth the volume recorded in 1938 and Mississippi about one-tenth the volume in 1939 when local supplies began to fail. Texas, Louisiana, California, Oklahoma, and West Virginia maintained that order of rank as in 1941 and 1942. These five States produced 82 percent of the total output in 1943. Texas, Louisiana, and California gained 13 percent, Oklahoma 6 percent, and West Virginia 4 percent over the 1942 production.

Natural gas produced in the United States and delivered to consumers, 1939-43, by States, in millions of cubic feet

Year	Arkan- sas	Calif- ornia	Colo- rado	Illi- nois	Indi- ana	Kan- sas	Ken- tucky	Louis- iana	Mich- igan	Missis- sippi	Mont- ana	New Mexi- co
1939.....	10,107	348,361	2,015	2,746	791	80,556	47,771	294,370	10,726	14,527	23,178	60,284
1940.....	14,379	351,950	2,833	8,359	1,137	90,003	53,059	343,191	12,648	6,365	26,231	63,990
1941.....	19,148	374,905	3,256	10,053	1,522	111,121	69,067	403,855	13,916	4,268	28,499	64,655
1942.....	19,456	403,968	4,865	14,484	1,599	112,921	80,089	447,686	15,521	2,082	31,475	78,164
1943.....	36,469	457,757	6,445	18,120	1,450	133,729	92,364	505,294	18,006	1,461	31,562	86,500

Year	New York	Ohio	Okla- homa	Penn- sylv- ania	Texas	West Vir- ginia	Wyo- ming	Other States	Total	Value at points of consumption	
										Total (thou- sands of dollars)	Aver- age per M cubic feet (cents)
1939.....	29,222	36,469	250,875	93,882	979,427	159,226	26,614	5,609	2,476,756	534,240	21.6
1940.....	12,187	40,639	257,626	90,725	1,063,538	188,751	27,346	5,568	2,660,222	577,939	21.7
1941.....	10,456	41,858	234,054	92,819	1,086,312	207,681	29,284	5,929	2,812,658	621,333	22.1
1942.....	8,718	45,055	269,704	93,532	1,170,345	215,193	33,124	5,494	3,053,475	692,737	22.3
1943.....	8,062	52,001	285,045	93,543	1,323,885	223,787	34,351	4,858	3,414,689	760,950	22.3

Natural gas produced and consumed in the United States in 1943, by States

State	Produced and delivered to consumers, including deliveries in other States					Consumed, including receipts from other States				
	Quantity		Estimated value at wells		Value at points of consumption		Quantity		Value at points of consumption	
	M cubic feet	Per- cent of total	Total	Aver- age per M cubic feet (cents)	Total	Aver- age per M cubic feet (cents)	M cubic feet	Per- cent of total	Total	Aver- age per M cubic feet (cents)
Ala.....							40,123,000	1.2	\$9,360,000	23.3
Ariz.....							24,048,000	.7	6,722,000	28.0
Ark.....	36,469,000	1.1	\$868,000	2.4	\$4,926,000	13.5	82,825,000	2.4	11,187,000	13.5
Calif.....	457,757,000	13.4	29,800,000	6.5	117,963,000	25.8	457,757,000	13.4	117,963,000	25.8
Colo.....	6,445,000	.2	226,000	3.5	1,425,000	22.1	31,424,000	.9	10,397,000	33.1
D. C.....							6,754,000	.2	4,707,000	69.7
Fla.....							4,033,000	.1	916,000	22.7
Ga.....							33,280,000	1.0	11,088,000	33.3
Ill.....	18,120,000	.5	884,000	4.9	2,857,000	15.8	122,340,000	3.6	49,950,000	40.8
Ind.....	1,450,000	(1)	153,000	10.6	1,142,000	78.8	39,227,000	1.2	17,687,000	45.1
Iowa.....							28,687,000	.8	9,907,000	34.5
Kans.....	133,729,000	3.9	6,513,000	4.9	49,618,000	37.1	129,173,000	3.8	27,107,000	21.0
Ky.....	92,364,000	2.7	13,605,000	14.7	39,831,000	43.1	23,409,000	.7	10,100,000	43.1
La.....	505,294,000	14.8	16,675,000	3.3	87,829,000	17.4	290,651,000	8.5	31,060,000	10.7
Mad.....							2,395,000	.1	1,673,000	69.9
Mich.....	18,006,000	.5	2,661,000	14.8	12,567,000	69.8	53,010,000	1.6	43,045,000	81.2
Minn.....							33,501,000	1.0	11,641,000	34.7
Miss.....	1,461,000	.4	100,000	6.8	385,000	26.4	30,113,000	.9	8,013,000	26.6
Mo.....	124,000	(1)	10,500	8.5	67,000	54.0	59,577,000	1.8	25,053,000	42.1
Mont.....	31,562,000	.9	1,471,000	4.7	8,006,000	25.4	28,815,000	.8	6,951,000	24.1
Nebr.....							20,462,000	.6	7,740,000	37.8
N. Mex.....	\$86,500,000	2.5	1,263,000	1.5	13,926,000	16.1	52,126,000	1.5	5,638,000	10.8
N. Y.....	\$8,062,000	.2	1,988,000	24.7	5,994,000	74.3	27,787,000	.8	20,894,000	74.9
N. Dak.....	177,000	(1)	5,000	2.8	60,000	33.9	2,030,000	.1	786,000	38.7
Ohio.....	52,001,000	1.5	8,559,000	16.5	27,255,000	52.4	162,371,000	4.8	85,223,000	52.5
Okla.....	285,045,000	8.3	9,492,000	3.3	42,503,000	14.9	230,423,000	6.8	27,186,000	11.8
Pa.....	\$93,543,000	2.7	21,477,000	23.0	45,272,000	48.4	159,004,000	4.7	66,181,000	41.6
S. Dak.....	6,000	(1)	200	3.3	2,000	33.3	7,483,000	.2	2,423,000	32.4
Tenn.....	10,000	(1)	1,000	10.0	6,000	60.0	24,252,000	.7	7,363,000	30.4
Tex.....	\$1,323,885,000	38.8	32,303,000	2.4	199,659,000	15.1	1,059,329,000	31.1	87,795,000	8.3
Utah.....	4,464,000	(1)	153,000	3.4	962,000	21.6	20,303,000	.6	4,410,000	21.7
Va.....	77,000	(1)	7,300	9.5	74,000	96.1	1,610,000	(1)	1,450,000	90.1
W. Va.....	223,787,000	6.5	27,548,000	12.3	91,679,000	41.0	94,315,000	2.8	23,876,000	25.3
Wyo.....	34,351,000	1.0	1,130,000	3.3	6,942,000	20.2	20,842,000	.6	3,522,000	16.9
Total:										
1943.....	3,414,689,000	100.0	176,893,000		5,276,950,000	22.3	3,403,479,000	100.0	758,937,000	22.7
1942.....	3,053,475,000	100.0	154,236,000		5,169,737,000	22.7	3,044,773,000	100.0	691,167,000	22.7

¹ Less than 0.05 percent.

² Includes 1,453,000 M cubic feet piped to Mexico.

³ Includes 32,000 M cubic feet piped to Canada.

⁴ Includes 99,000 M cubic feet piped to Canada.

⁵ Includes 9,626,000 M cubic feet piped to Mexico.

The average value of gas at the wells in 1943 continued the upward trend begun in 1941 and was 5.2 cents—0.1 cent above the 1942 average. The average value at points of consumption in 1943 reflected the increase in industrial consumption and lower prices. It was 22.3 cents per thousand cubic feet compared with 22.7 cents in 1942.

In 1940 and in 1943 the five principal southwestern gas-producing States supplied 68 percent of the total marketed production in the United States, at average values at the wells of 2.1 cents and 2.8 cents per thousand cubic feet respectively. The share of the Appalachian group of five States in total marketed production declined only slightly in this period (from 15 to 14 percent) as the average field price advanced from 14.8 cents to 15.6 cents.

WELLS

The total of gas-well completions in 1944 reached 3,069, or 34 percent above 1943, as drilling revived after 2 years of decline. Progressive relaxation of well-spacing controls by the Petroleum Administration for War and improved availability of materials helped to stimulate development. More new wells were reported in 17 States than in 1943, with outstanding gains in Texas, West Virginia, Pennsylvania, and Oklahoma. Drilling was active in the major dry-gas fields of the Southwest and in a number of condensate fields in the Gulf Coast region. New productive capacity was developed for expanding markets for natural gas and the liquids obtained from it.

The number of producing gas wells increased during 1943 from 56,150 on January 1 to 57,200 on December 31. The indicated number of gas wells abandoned or shut in during 1943 was 1,240, of which over 80 percent was in the five eastern producing States. These States had about 78 percent of all the gas wells in the United States on December 31, 1943.

Gas wells in the United States, 1942-44, by States

State	Producing Dec. 31, 1942	Drilled during 1943 ¹	Producing Dec. 31, 1943	Drilled during 1944 ¹
Arkansas.....	200	3	190	2
California.....	130	38	170	50
Colorado.....	20	1	26	1
Illinois.....	80	12	80	6
Indiana.....	940	19	940	28
Kansas.....	1,950	43	1,990	93
Kentucky.....	² 2,650	210	² 2,850	305
Louisiana.....	1,730	72	1,790	82
Michigan.....	520	47	560	64
Mississippi.....	20	-----	20	1
Missouri.....	120	5	110	5
Montana.....	460	51	500	81
New Mexico.....	120	8	120	9
New York.....	2,000	10	2,000	5
Ohio.....	6,750	455	6,900	480
Oklahoma.....	2,250	112	2,330	212
Pennsylvania.....	18,500	583	18,600	725
Tennessee.....	(³)	-----	(³)	1
Texas.....	3,460	140	3,560	270
West Virginia.....	14,100	475	14,310	640
Wyoming.....	120	5	120	7
Other States ¹	30	1	30	2
	56,150	2,290	57,200	3,069

¹ From Oil and Gas Journal and State sources.

² Tennessee included with Kentucky.

³ North Dakota, South Dakota, Utah, and Virginia.

TECHNOLOGIC DEVELOPMENTS

Chemical processing of the constituents of natural gas has emerged during the war from comparative obscurity to play prominent roles in a number of essential industrial programs. Its potentialities, as sketched in recent technical literature, appeal to the imagination, for the promises of growth and even of revolutionary change involve many and varied fields of production.

Although the volume of natural gas and associated liquefied gases utilized as chemical raw materials has increased rapidly since 1941, the total is very small compared with that sold for fuel. The impact of all of these chemical activities upon the established business of marketing natural gas has therefore been scarcely felt. More significant economic change has doubtless occurred in some branches of the chemical industry (as distinguished from petroleum refining), where the scale of production is relatively small and unit values of products are high.

From the standpoint of the producer of natural gas the most important chemical developments are doubtless those that have made possible the conversion of methane into motor fuel and other useful products at currently competitive costs. It has been announced that equipment is now commercially available that will produce a high-grade gasoline at 5 cents per gallon from natural gas costing 5 cents per thousand cubic feet, the yield being about 4 gallons per thousand cubic feet. Other liquid hydrocarbons, including 100 cetane Diesel fuel, and waxes of unusual character can also be produced at commercial costs. This and similar processes may provide a profit motive for the conservation of natural gas and refinery vapors by opening important new markets to these materials. Several experimental pilot plants are in operation, and commercial installations are expected to follow.

Much of the current utilization of natural gas as a raw material for chemicals results from the demand for hydrogen, which enters into many industrial processes, including the manufacture of synthetic ammonia, hydrochloric acid, and methanol; the hydrogenation of oils of petroleum and other origins; and fabrication of metals. A cheap supply of hydrogen is obtained from thermal decomposition of natural gas or its reaction with steam, with byproducts of carbon black in the first instance and carbon dioxide in the second.

In the manufacture of synthetic rubber, butane and butylene are processed to produce butadiene, and propane is cracked to ethylene, an intermediate in styrene production. Whole series of new substances are being created from light hydrocarbons by such chemical techniques as regenerative cracking, chlorination, nitration, and oxidation controlled by catalytic action.

The development of Diesel engines that are convertible under full load from oil to gaseous fuel, with a claimed efficiency about 30 percent higher than older engines operating on gas, may lead to a broader use of gas for power generation. This type of prime mover would be valuable at locations where natural gas is available at low cost, except during periods of peak demand, when a stand-by oil supply could be substituted.

The adaptability of carbon black (a product of natural gas), and rubberlike materials with which it is compounded, to broader fields of

usefulness has resulted from recent intensive research. Thus a larger demand for carbon black has developed in "rubber" and in the growing field of plastics as a filler and pigment.

The "pressure-weld" method came into prominent use in pipe-line construction for the first time in 1944. It involves clamping the ends of pipe lengths that are to be joined in a patented device in which they are heated by application of oxyacetylene flames. The ends, when raised to a closely controlled temperature below the fusion point, are forced together under pressure to form a strong joint or weld. Savings in labor and total cost, as compared with other welding methods, are claimed.

One of the most interesting technical developments in the industry in recent years came to a tragic end in 1944. The liquefied-gas storage plant that began operations in February 1941 as an auxiliary gas supply to meet the peak-load requirements of Cleveland, Ohio, was demolished by fire with heavy loss of life and property.² Although this unique project had been successful technically and financially, reconstruction is not contemplated at present. Means of caring for the city's gas needs have been provided by new pipe-line connections with western gas supplies and additional underground gas storage capacity.

POSTWAR OUTLOOK

The vigorous growth-trend of the natural-gas industry is indicated by the graph of marketed production (fig. 1). The quantity of gas marketed in 1943 was 120 percent above that in 1933 and exceeded the predepression peak in 1930 by 76 percent. For the United States as a whole the reserves of gas appear to be adequate for many years, and markets exist for more gas than is being distributed at present. A comparison of the average values of natural gas at points of consumption with costs of competing fuels since 1939 suggests that the competitive cost position of natural gas has not deteriorated but, on the contrary, has improved for some applications. Therefore, on economic grounds alone, the expectation of continued expansion in natural-gas sales in the period following the war appears amply justified.

Referring again to figure 1, it may be seen that the upward course of the marketed-production curve has been interrupted only three times since 1916. On each occasion the cause was a sharp decline in the industrial production of the country, which was reflected by a relatively small contraction in natural-gas sales. If industrial activity and national income drop sharply after hostilities cease, a material decline in gas marketing doubtless would occur; however, with the passing months this possibility appears more likely to exert only a minor, short-lived influence upon the demand for gas.

The current efforts to restrict by political action the transportation of natural gas from several southwestern producing States to other States for consumption if successful, would retard or prevent the expansion of natural-gas distribution, particularly in the Eastern and Northern States. It has been stated that such restriction of interstate commerce is beyond the powers granted the States under the Federal Constitution.

² Seibel, C. W., Elliott, M. A., Brown, F. W., Artz, R. T., and Berger, L. B., Reports on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, on October 20, 1944; Bureau Mines Rept. of Investigation. In press.

Also bearing upon the question, however, will be the results of the investigation of the natural-gas industry by the Federal Power Commission, briefly discussed in the Law and Administration section of this chapter. If the conclusions drawn from its study of the end uses to which natural gas may be put in the public interest call for the elimination of some types of large-scale industrial consumption, the restraint thus placed upon future growth of the industry would apply with comparable force to the interstate movement of gas.

The average value of natural gas at the wells has risen slowly since 1940, which marked the end of a consistent decline of many years duration. The reversal in trend probably reflects the gradual absorption of tremendous amounts of available distress gas, mostly in "dry" gas fields, for which no market was provided as rapid development of productive capacity proceeded. The dynamic expansion of gas markets has been the fundamental cause of this desirable change from the standpoint of conservation and of the owners of gas reserves.

It is expected that a firm trend in values of natural gas at the wells will continue to be supported by growing utilization of gas for consumption and for improving the efficiency of oil production. Measures of control applied from outside the gas industry might modify the rate of progress and the forces that determine the price of gas in the field.

The pressure exerted by competing services and by State and Federal regulatory authorities upon domestic and commercial rates for natural gas has influenced the declining average cost to these consumers during the past 10 years. Continuation of this force may be expected to foster a growing demand from small consumers and to shift more of the financial burden of maintaining gas service to the large industrial users, whose unit cost of gas may be expected to rise, except in areas of surplus gas supply.

The result of these trends will be to increase the proportionate amount of gas used for domestic and commercial purposes relative to total marketed production.

REVIEW OF FIELD DEVELOPMENTS, BY STATES

Arkansas.—Figures of production and consumption of natural gas in Arkansas in 1944 were submitted by L. L. Jordan, chief engineer, Arkansas Oil and Gas Commission.

There were 177 gas wells producing in 25 fields in the State at the close of the year compared with 192 wells in 23 fields in 1943. Two gas wells were completed in the northern gas fields in 1944 and 3 in 1943.

The Columbia and Texarkana pools—both gas-producing areas in southwestern Arkansas—were closed during the greater part of 1944 for lack of a market.

Natural-gas production increased 35 percent from 59,655 million cubic feet in 1943 to 80,667 million in 1944. Of the 1944 output, 61,028 million (76 percent) came from the controlled and 14,809 million (18 percent) from the uncontrolled oil and gas fields of southern Arkansas, and 4,830 million (6 percent) from the northern gas fields. Comparative figures for 1943 are: 47,782 million (80 percent), 6,243 million (11 percent), and 5,630 million (9 percent), respectively. These amounts indicate a 40-percent increase in output from the southern and a 14-percent decrease in output from the northern fields.

The gain in southern Arkansas is due largely to completion of the McKamie Gas Cleaning Co. plant and to development in the Dorcheat-Macedonia field.

Total gas vented was 21 percent of production in 1943 and 26 percent in 1944. The greater part is gas impractical to gather because of its volume and physical characteristics.

Gasoline plants processed 31,801 million cubic feet of gas from controlled fields and 14,809 million from uncontrolled fields in 1944 compared with 24,809 million from controlled and 6,243 million from uncontrolled fields in 1943. Fifty-six percent of the residue gas was sold commercially in 1944 compared with 55 percent in 1943.

Gas from the southern fields was distributed in 1944 as follows: Field fuel 4,038 million cubic feet, gas lift 252 million, gasoline-plant fuel 3,305 million, shrinkage at gasoline plants 5,932 million, sold 31,930 million, recycled or returned to formations 10,512 million, and vented 19,868 million. These figures represent gains over the 1943 record in all classifications except gas used for gas lift, which decreased 70 percent.

Gas in northern Arkansas was sold for light and fuel.

California.—About 10 exploratory and 50 development gas wells were drilled in California during 1944 in an effort to meet an ever-increasing demand for natural gas.

The following information on natural-gas developments was taken from a report supplied by E. F. McNaughton, Railroad Commission of California.

Prospecting for new dry-gas wells increased in the northern part of the State during the year, and there were several gas discoveries. A promising one was the Suisun Bay field in Solano County, where 300 feet of gas sand was found in some tests. No information as to the extent of the productive area was given. Gas was also found in the Chico area of Butte County, in the Ord Bend field 11 miles west of the city of Chico in Glenn County, and in the southeastern corner of the same county. A discovery 9 miles northwest of the Trico field (11 miles west of the city of Delano) was apparently in the same trend as the Trico field. One new area was 18 miles northwest of the Thornton field (22 miles south of Sacramento), and another was in the Kirby Hills region of Solano County. The Thornton gas field was extended a mile to the west.

Fourteen wells were drilled in the Rio Vista gas field in 1944, and pipe-line connections were made to facilitate larger withdrawals of gas.

The most important pipe line built during the year was one from the La Goleta underground storage project to the Los Angeles market. It was the key line for most of the new gas lines built in southern California. During times of peak demand the gas will flow toward Los Angeles, and in off-peak seasons it will flow toward the field for storage. Four new wells were drilled to increase the rates of injection and withdrawals, and new compressor units were installed. It is expected that the line will make available 160 million cubic feet of gas daily above the capacity of lines formerly serving the region. Part of the supply will come from a recently discovered reserve in the lower zones of the Ventura Avenue field which existing lines would not have been equipped to transport. The line will tend to obviate the necessity of selling high-grade surplus gas in off-peak seasons to industries that could use lower-grade fuels.

The Playa del Rey storage field has proved to be a satisfactory project. A study conducted by the Railroad Commission and the Division of Oil and Gas found that the only important migration of gas was into an area where satisfactory agreements for its return were in practice. The field was valuable in making an adequate supply of gas available to meet peak demands during the winter of 1944.

Growth in the civilian population and increased demands of war industries caused a material increase in the use of natural gas in 1944. Dry-gas production totaled 186,778 million cubic feet, a 21-percent increase over the 1943 record. The Rio Vista gas field furnished 84 percent of the total dry-gas output in both 1943 and 1944. A total of 361,859 million cubic feet of gas was distributed by gas companies in 1944. Domestic and commercial consumption took 161,599 million cubic feet; industrial consumption, including company use, 181,716 million; unaccounted-for gas, 13,509 million; and net storage, 5,035 million. In addition to the above, 60,656 million cubic feet were delivered to oil fields and to other consumers.

Pressure maintenance is being practiced increasingly in the oil fields. The amount of casinghead gas available for distribution will therefore be decreased, but the output of oil probably will be increased.

R. M. Bauer, gas-supply supervisor, Southern California Gas Co., supplied the following information.

A total of 8,656 million cubic feet of gas was stored in the Buena Vista Hills, La Goleta, and Playa del Rey fields in 1944—37 percent over the 6,341 million stored in 1943 and 34 percent over the 6,442 million stored in 1942.

Production in California totaled 549,431 million cubic feet in 1944 (not including 69,495 million used for repressuring), a 16-percent gain over that reported in 1943. Of the total, 186,778 million cubic feet were produced by gas wells and 362,653 million by oil wells. Comparative figures for 1943 are 154,323 million cubic feet from gas wells and 318,654 million (not including 48,105 million used for repressuring) from oil wells. Unconserved gas comprised 9,928 million cubic feet in 1944 compared with 6,892 million in 1943. Utilized production and net gas withdrawn from storage in 1944 was distributed as follows, in millions of cubic feet: Domestic and commercial use, 160,208; gasoline-plant shrinkage, 26,995; field and plant fuel, 89,444; refinery and pump-station fuel, 69,830; fuel at steam electric generating plants, 48,719; company use, 4,900; other industrial uses, 121,919; and gas unaccounted for by gas companies, 13,604.

California retained first place among the States in the number of consumers using natural gas in 1944.

Colorado.—J. R. Schwabrow, acting supervisor, Geological Survey, United States Department of the Interior, Casper, Wyo., reports only one gas development in Colorado during 1944. It was a deep test on the White River dome in the north central part of Rio Blanco County drilled to 7,005 feet in 1943 and plugged back for tests in 1944. A productive capacity of 500,000 cubic feet or more of gas and a small amount of condensate were found in the Wasatch and Mesa Verde formations between 5,626 and 5,909 feet. This well and a small one completed at 5,987 feet in the same area in 1930 were shut in during the year. Most of the shallow wells in the field have been abandoned as nonproductive.

A pilot plant for separating carbon dioxide from oil was built in the North McCallum field. Tests showed that the gas could be profitably returned to formations. A combined plant equipped to extract the oil and return the carbon dioxide to the reservoir at the rate of possibly 30 million cubic feet daily will be put in operation in 1945.

Hiawatha field with a 15-percent and Powder Wash with a 5-percent decline from the 1943 record furnished 95 percent of the marketed production in Colorado in 1944, compared with 96 percent in 1943. Production by fields, in millions of cubic feet, follows: Hiawatha 3,158, Powder Wash 1,450, Thornburg 218, Berthoud 43, and Craig 3. The volume of casinghead gas from the Wilson Creek oil field, where 8 oil wells were completed, increased. The gas : oil ratio is about 285 cubic feet per barrel.

Natural-gas production in 1944 totaled 5,987 million cubic feet, a 3-percent decline from the 6,148 million reported in 1943. Marketed production declined 11 percent from 5,460 million cubic feet in 1943 to 4,872 million in 1944. Gas used for recycling or repressuring totaled 453 million cubic feet, compared with 273 million in 1943. There were 207 million cubic feet used in the field and 455 million lost, gains over the 1943 record of 18 and 90 percent, respectively.

Illinois.—A report by Alfred H. Bell, geologist, and David H. Swann, associate geologist, Illinois State Geological Survey, gives the following information relative to natural-gas developments in Illinois during 1944.

The only gas completions were three in the Bridgeport sand of the Russellville field in Lawrence County. This compares with five completions in the Russellville field and one in the Ayers field in 1943.

Production from gas wells constituted little more than 1 percent of the total output in Illinois in 1944. Gas from the Russellville and Ayers gas fields and some residue gas from natural-gasoline plants in the Salem and Loudon oil fields is marketed for domestic and industrial uses outside of the petroleum industry. The gas thus utilized was between 2 and 3 percent of a total output of 45 to 60 billion cubic feet.

Natural-gasoline plants processed about 22 billion cubic feet of casinghead gas from the Benton, Dale-Hoodville, Loudon, New Harmony, Salem, and Southeastern oil fields. About one-half of the 15 to 17 billion cubic feet of residue gas was returned to formations, one-third was used as plant or lease fuel, 725 million cubic feet were marketed commercially, and over 2 billion were burned in flares.

In areas where there are no pipe-line connections or gasoline plants, it is estimated that over half of the gas produced is used for fuel on the leases. Less than one-sixth of the total production in Illinois in 1944 was vented or burned in flares. These figures show great improvement over the 1943 record, when a large part of the output was reported as wasted.

Indiana.—A report by Otis V. Freeman, acting State geologist, states that 28 gas wells were drilled in Indiana during 1944. The largest one was in the Rockport field. Its initial output was 2,680,000 cubic feet daily.

The most productive gas fields in the State are the Rockport, Spencer County, the Greensburg, Decatur County, and the Unionville, Monroe County.

No estimate of gas production for 1944 was given.

The small marketed production of natural gas has been relatively stable since 1916. In recent years, increased oil-production activity has helped sustain gas output against the declining capacity of sources of dry gas.

Kansas.—L. B. Taylor of the Conservation Division of the Corporation Commission of Kansas states that there was extensive drilling in the Hugoton field, and additional reserves were discovered in the Lake City area of Barber County in 1944. The Kansas Power & Light Co. has applied for a permit from the Federal Power Commission to connect the new field to its distribution system. No new transmission lines from Kansas fields were built during the year.

Production was reported from 30 fields in 1944 compared with 25 in 1943. Chitwood was the new field reporting the largest yield (1,853 million cubic feet). The Hugoton field ranked first in output, with Medicine Lodge second and Otis third. The Hugoton area gained 31 percent over 1943 (62 percent of the State's output in 1944 compared with 52 percent in 1943). Medicine Lodge increased 5 percent and Otis decreased 9 percent. The Cunningham (Viola) field declined from 7,773 million cubic feet in 1943 to 5,709 million in 1944 and Burrton from 6,442 million to 2,465.

Production by major fields in billions of cubic feet follows: Hugoton, 83.0; Medicine Lodge, 14.4; Otis, 12.1; Cunningham (Viola), 5.7; Burrton, 2.5; Chitwood, 1.9; Cunningham (Arbuckle), 1.2; McLouth, 1.2; and Alden, 1.2. East Kansas production is estimated at 5,700 million cubic feet in 1944 compared with 6,300 million in 1943, a 10-percent decline. Gas sales totaled 134,703 million cubic feet in 1944, 10 percent over the 122,089 million reported for 1943.

Kentucky.—Mrs. Louise B. Freeman, assistant State geologist, Department of Mines and Minerals, reports that there were no significant changes in the natural-gas industry in Kentucky during 1944.

Of 229 gas wells drilled in the State during the year, only 2 were in western Kentucky. The remainder were in more or less proved areas in 9 counties in the eastern fields. These figures compare with 210 wells drilled in 17 counties in 1943. Pike County maintained first place in number of gas completions as compared with the 1943 record, and Floyd and Martin Counties displaced Knott in second rank. Completions in eastern Kentucky in 1944 were as follows: Pike County 80, Floyd 43, Martin 43, Knott 30, Jackson 9, Johnson 8, Magoffin 7, Clay 6, and Knox 1.

The new wells added 2,603,000 cubic feet daily to the total productive capacity. Counties having the largest daily average were: Martin 674,000 cubic feet, Pike 529,000, Magoffin 491,000, Floyd 316,000, and Johnson 242,000. Over one-half of the State gas production comes from the Chattanooga black shale.

There were 3,000 to 3,100 producing gas wells in eastern Kentucky in 1944 with a total daily average production of from 175 to 200 million cubic feet. No figures of production for the year are available, but a slight increase is indicated in spite of shortages of manpower and materials.

Louisiana.—Gas-well completions in 1944 numbered 82, of which 67 were in the Northern and 15 in the Southern district. The most active fields were Monroe with 40 completions, Lisbon 6, and Holly Ridge 4.

Exploratory drilling in North Louisiana resulted in the discovery of two distillate fields—Benton in Bossier Parish, producing from the Cotton Valley formation at 8,000 feet, and Tremont in Lincoln Parish, producing from the Cotton Valley below 9,000 feet. Distillate production in the Cotton Valley field, Webster Parish, was extended and a new pay sand opened. New gas fields were found in Bienville, De Soto, Lincoln, and Webster Parishes. The discovery of the first oil in Richland Parish in the northeastern part of the State opened an extensive new area to oil and gas exploration.

In South Louisiana, four distillate fields and two dry gas fields were discovered. The distillate fields were: Bayou Penchant in Terrebonne Parish, College Point in St. James, South Lake Charles in Calcasieu, and Laurel Ridge in Iberville. These fields all produced from the Miocene at depths between 9,900 and 10,800 feet. New dry-gas fields were reported at West White Lake, Vermilion Parish, and Houma, Terrebonne Parish, also producing from the Miocene below 10,000 feet.

The largest cycle plant in the country commenced operations in the Erath distillate field, Vermilion Parish, in April 1944, after about 2 years devoted to engineering studies of the field, organization of all owners of fee and leases for unit operations, and actual construction. The processing of slightly more than 200 million cubic feet of gas daily yielded initially about 16,000 barrels per day of light liquid products. Almost 90 percent of the volume of gas produced is returned to the productive sands, of which there are about 19 in all, at the unusually high injection pressure of 4,600 pounds or more.

Two furnace-type carbon-black plants were built in 1943 to operate on waste casinghead gas in the Eola and Ville Platte fields. This type of loss from oil production was thereby reduced.

Louisiana natural-gas production totaled 799.5 billion cubic feet in 1944, a gain of 100 billion over 1943, according to data released by the Louisiana Conservation Commission.

Michigan.—According to F. R. Frye, petroleum engineer, Michigan Department of Conservation, 64 wells were completed in 1944 compared with 47 in 1943. The only discoveries were one each in Mecosta, Newaygo, and Ogemaw Counties, all undeveloped at the close of the year. Of the new wells, 13 were drilled in the Goodwell field of Newaygo County discovered in 1943, 13 in the Cranberry Lake field, 8 in the Woodville, and 8 in the West Evart field.

The West Evart, West Fork, and Ithaca fields were connected with gas-transmission systems during the year, and 8-inch lines were laid from the Woodville and Goodwell fields.

The Reed City gas field, purchased late in 1944, is to be used for gas underground storage.

Production in Michigan in 1944 increased 8½ percent over the 1943 output to 21,254 million cubic feet, an all-time high.

Mississippi.—Exploratory drilling in southern Mississippi yielded good results in 1944. The Gwinville field, a large reserve of natural gas and condensate with production from the Lower Eutaw and Upper Tuscaloosa formations, was discovered on July 26, 1944. Later development indicated reserves of gas and condensate in other sands of the Tuscaloosa.

H. M. Morse, supervisor, State Oil and Gas Board of Mississippi, reports that no new pipe lines were built in 1944, and no new regulations affecting natural-gas operations were made.

He reported natural-gas production in three fields as follows: Jackson gas field in Hinds and Rankin Counties, 851,736,000 cubic feet; the new Gwinville gas and distillate field in Jefferson Davis County, 55,801,000 cubic feet; and the new Bruinsburg gas field in Claiborne County, 9,574,000 cubic feet.

A cooperative oil and gas engineering committee was organized to collect and distribute to members technical and statistical information of a factual nature relating to the business of oil and gas production.

Missouri.—Frank C. Greene, geologist, Missouri Geological Survey, reports five small wells completed in Missouri during 1944, the same number as was reported in 1943. There were no new developments.

A pipe-line connection was completed between the Prairie Point pool in Platte County and the Fairfax industrial district in Kansas City, Kans.

Production is estimated by purchasing companies in the State at 152,547,000 cubic feet valued at \$22,430. Reported production in 1943 was 124,000,000 cubic feet valued at \$10,500 at the wells.

Montana.—J. R. Schwabrow, acting superintendent, Geological Survey, United States Department of the Interior, Casper, Wyo., has supplied information relative to natural-gas developments in Montana during 1944.

There were 81 gas wells drilled during the year, with a total open flow of 116,000 thousand cubic feet, compared with 51 completions in 1943 having a total open flow of 64,640 thousand cubic feet. A new field was discovered by a well in the northern part of Toole County which found gas in the top of the Madison limestone at 2,040 feet. Its open flow was estimated at 20 million cubic feet, with a shut-in pressure of 580 pounds. The only other discovery well, drilled to 2,331 feet in western Liberty County, also found gas in the top of the Madison limestone. Its open flow was 5 million cubic feet with shut-in pressure of 1,025 pounds. Neither of the new fields was put on production. The number of gas-well completions by fields follows: Bowdoin 52, Cedar Creek 17, Kevin-Sunburst 5, Cut Bank 3, Kicking Horse 2, Utopia 1, and Devon 1.

The output of the Cedar Creek, Cut Bank, and three of the smaller fields decreased slightly; all others registered gains. The Cut Bank field supplied 48 percent of the total marketed output in 1944 compared with 50 percent in 1943. Fields and the amount of gas marketed, in millions of cubic feet were: Cut Bank 14,926, Cedar Creek 5,867, Bowdoin 4,762, Kevin-Sunburst 2,047, Whitlash 1,066, Dry Creek 1,046, Bowes 506, Boxelder 456, Devon 344, Marias River 158, Haystack Butte 95, and Hardin 76.

Natural-gasoline plants in the Cut Bank and Dry Creek fields processed 12,278 million cubic feet of gas to produce 2,730 thousand gallons of natural gasoline in 1944 compared with 11,524 million cubic feet processed and 2,793 thousand gallons of gasoline produced in 1943. The plant in the Cut Bank field also produced 1,684 thousand gallons of propane-butane mixture and 200 thousand gallons of straight propane.

Gross production increased 4 percent from 31,597 million cubic feet in 1943 to 32,975 million in 1944. Repressuring and recycling accounted for 25 million, field use for 1,115 million, and losses for 486 million. Comparative figures for 1943 are 35 million, 1,038 million, and 199 million, respectively. Marketed production increased 3 percent over the 1943 total from 30,325 million cubic feet to 31,343 million.

New Mexico.—L. G. Snow, supervisor, Geological Survey, United States Department of the Interior, reports six gas completions in southeastern New Mexico in 1944 having a total daily initial production of 16.4 million cubic feet. Three of them discovered new production from Permian formations—two in Lea County at depths of 3,050 to 3,200 feet and 4,707 to 4,802 feet had initial productions of 2 million and 2.2 million cubic feet, respectively, and one in Eddy County at a depth of 703 to 710 feet had an initial production of 5.7 million cubic feet. The other three were in the upper zones of the Arrowhead and Lynn oil fields of Lea County and the Barber oil field of Eddy County. In 1943 there were two completions in Lea County and one in Eddy County.

In northwest New Mexico, six wells were completed in San Juan County compared with five in 1943. Three of the 1944 completions found gas in the Dakota sand in the Barker Creek gas field and three in the Pictured Cliffs sand in the Fulcher Basin gas field. Their total daily initial production was 22.3 million cubic feet. It was hoped that known gas reserves would be increased by a deep well begun in 1944 in the Barker Creek field. It is planned to test all formations down to granite at an estimated depth of about 10,000 feet. No information was given as to the progress of this test.

Plans are being made for enlarging the carbon-black plant operating in Lea County and for constructing two new plants. The shortage of carbon black essential in the manufacture of synthetic rubber has gained a high priority rating for the work. Two repressuring plants in Eddy County have installed additional cooling and absorption equipment and are now operated as natural-gasoline extraction plants. A 16-inch gas line was constructed during the year to carry residue gas from a gasoline plant in the Eunice field to a storage project in the Rhodes field in Lea County. A compression station was built near the plant.

Nine wells in the Bueyeros area, Harding County, produced 209.9 million cubic feet, and three wells in the Estancia area in Torrance County 15 million cubic feet of carbon dioxide gas. Both liquid and solid carbon dioxide is being made from the gas.

The reservoir pressures in Eddy County are no longer sufficient for direct connection with high-pressure gas lines, hence dry gas is now sold only for minor fuel and heating purposes. A more efficient use of gas from oil wells and of residue gas from gasoline plants probably will result from this condition. Sales of residue gas in 1944 were virtually the same as in 1943. The volume of gas returned to oil-producing formations increased about 10 percent over the 1943 record.

Natural-gas production in southeastern New Mexico totaled 127,223 million cubic feet in 1944. Of this amount 90,902 million was marketed or used in the field, 33,433 million was vented to the air, and 2,888 million was returned to formations. Natural-gasoline

plants processed 104,258 million cubic feet in 1944 compared with 98,859 million in 1943.

Gas sold for domestic and commercial uses in northwest New Mexico totaled 4,956 million cubic feet compared with 4,807 million in 1943. The amount vented or used in the field in that area during 1944 was not reported.

New York.—Efforts to find new supplies of natural gas in New York have yielded small returns in recent years.

C. A. Hartnagel, former State geologist, reports only one producing well among 17 wildcats drilled to the Oriskany sandstone in Allegany, Steuben, Chemung, and Schuyler Counties in 1944. It had an initial daily production of 9,000,000 cubic feet and is in Tuscarora Township, Steuben County, near the Woodhull gas field, formerly a highly productive area. Only 2 of 26 wells were successful in 1943.

The deepening of the discovery well in the Woodhull field, which was begun late in 1943, was continued to a depth of 8,625 feet in 1944 and reached the Ordovician formation, but only small flows of gas were encountered. It was originally a large producer at 3,957 feet in the Oriskany formation. A well begun in 1943 in Wyoming County reached a depth of 6,757 feet early in 1945 but showed only small flows of gas. Another well in the same area drilled to test the Medina sandstone was abandoned at 3,375 feet when only small production was found.

No new developments were reported in the old Trenton and Medina fields where a few wells are drilled from time to time as more natural gas is required.

New York produces less than one-third of the total State demand for natural gas. Large amounts of gas from other States are imported. Some of this gas is stored in depleted gas fields to build up a reserve for use in periods of peak demand.

No natural-gas production figures for New York were given, but it is probable that the decline that began in 1939 was continued in 1944.

North Dakota.—The only commercial gas found in North Dakota comes from Bowman County in the southwest corner of the State. Four wells were producing in 1944 compared with 7 in 1943. Gas is found in the Eagle sand or the Pierre shale in the Cedar Creek anticline.

The Montana-Dakota Utilities Co., which distributes the gas, has made a location for a well to be drilled in 1945. It is hoped that production may be increased by a number of new wells.

Total output in 1944 was 200,105,000 cubic feet—a 13-percent gain over the 1943 record. This information was supplied by Wilson M. Laird, State geologist, North Dakota Geological Survey.

Ohio.—The following information was furnished by Kenneth C. Cottingham, chief geologist, Ohio Fuel Gas Co.

There were no important discoveries in Ohio during 1944. Thirteen new gas pools—11 in the Clinton sand, 1 in the Oriskany, and 1 in the Berea—were opened. The largest pool comprised 1,000 acres and the average about 565 acres. Extensions were also made to some 15 known pools, and about 15 additional small pools proving close to 120 acres each were discovered. Approximately 1,000 acres were proved in the Clinton sand in Dover Township, Tuscarawas County; 700 in Huntington and 750 in LaGrange Townships, Lorain County;

and 650 in the Oriskany formation in Bath Township, Summit County.

Wells in all sands averaged smaller volumes than in 1943. The daily average production per new well in 1944 was 769,000 cubic feet compared with 913,000 in 1943. Clinton wells ranked first in average capacity in 1944, Oriskany second, and Newburg third. There were 9 more Clinton completions than in 1943, 36 more Berea, 3 more Oriskany, and 6 more Trenton. The number of completions in the Shallow sands declined 24, in Ohio shale 6, and in the Newburg 1.

The deepest Clinton test was in Harrison County. It was dry and was abandoned at 6,301 feet. The largest Clinton gas wells were 1 in Ashland County, 2,975 feet deep, and 1 in Lorain County, 2,449 feet deep. Each had an initial open flow of 12,000,000 cubic feet. The outstanding Oriskany well was in Columbiana County. Its open-flow capacity was 5,800,000 cubic feet at depths of 3,545 to 3,557 feet. Productive "sands" and number of wells drilled in each follows: Clinton 285, Berea 125, Shallow 33, Oriskany 20, Ohio shale 6, Trenton 6, and Newburg 3. In all, 478 gas wells were drilled, 23 more than in 1943. The number of dry holes was virtually the same as the previous year. Gas wells were drilled in 33 counties in 1944 compared with 29 in 1943. Stark County ranked first in the number of gas completions displacing Morgan County which dropped to sixth place. Muskingum County displaced Medina in second place. The highest-ranking counties and number of completions were: Stark 50; Muskingum 43; Lorain 35; Medina 34; Holmes 28; Noble 28; Morgan 26; Athens 25; Perry 23; and Monroe 21.

The first rotary well drilled in Ohio was begun in Belmont County in September 1944 and, in spite of difficult drilling, was completed by March 1945. It was bottomed at 7,455 feet in the Queenstown shale and abandoned.

Figures of natural-gas production in Ohio in 1944 are not yet available.

Oklahoma.—No gas reserves of major importance were discovered in Oklahoma during 1944. Twenty-three gas completions resulted from 373 wildcat wells compared with 23 from 310 wildcat wells in 1943. Garvin, Okfuskee, and Stephens Counties each had 3 gas discoveries, Lincoln 2, and Coal, Cotton, Hughes, Kay, LeFlore, Love, Okmulgee, Osage, Pawnee, Pittsburg, Pontotoc, and Seminole 1 each.

There were 82 gas wells drilled in the Hugoton field and 5 in the Cement. In all, about 212 gas wells were completed in the State during the year, an increase of 89 percent over the 112 drilled in 1943.

Elmer Capshaw, gas engineer, Oklahoma Corporation Commission, has supplied the following information. New discoveries fell far short of compensating for declines in reserves of old sands outside of the Hugoton field, and pipe-line companies were seeking new connections to meet increased demands for fuel gas. The Hugoton field was heavily drawn upon and will probably be more so in 1945. More gas was also piped from Kansas and Texas. In January 1944 gathering lines were connected with 43 wells in Texas County in the Hugoton field and took 1,047,125,000 cubic feet of gas. In the same period of 1945, 156 wells were connected from which 6,760,723,000 cubic feet were drawn.

Decreased local supplies will tend to increase the price of gas at the wells.

Production of casinghead gas has declined in recent years, and that of dry gas has increased. Figures for 1944 indicate 216,576 million cubic feet of dry gas taken by gathering lines—a 21-percent gain over the 1943 figure—and 125,184 million cubic feet of casinghead gas—a 9-percent decline from the 1943 figure. A total of 341,760 million cubic feet was reported for 1944—8 percent over the 316,938 million cubic feet reported for 1943.

Pennsylvania.—According to J. G. Montgomery, Jr., vice president, United Natural Gas Co., most of the drilling in Pennsylvania in 1944 continued to be in the shallow sands. Of 855 wells drilled in the shallow fields during the year, 625 (73 percent) produced gas. This compares with 770 drilled in 1943 of which 597 (75 percent) produced gas. Of the total, 454 were drilled in southwest Pennsylvania, 338 being productive, with a total daily open flow of 84,784,000 cubic feet. In the northern and central counties 287 of the 401 wells drilled were productive. Their total daily initial capacity was 39,900,000 cubic feet.

A test in Patton Township, Allegheny County, completed in December was the most important discovery of the year. Its daily initial open flow was 4,170,000 cubic feet, and rock pressure was 1,190 pounds per square inch. Production was in the Speechley sand. The probable extent of the pool was unknown at the end of the year. In McKean County there were 15 gas completions in a Haskill sand pool. Their daily initial volume averaged 200,000 cubic feet, and rock pressures were as high as 840 pounds per square inch. In Mercer County 6 of 10 wells drilled some distance northwest of known production in the shallow-sand area found gas in the Berea and Venango First sands at depths of 294 to 667 feet. Their daily initial open flows averaged 114,000 cubic feet.

Only three gas wells were completed in the deep-sand fields although exploratory drilling was unusually active. In Fayette County the Summit gas pool was extended by two wells with daily initial open flows of 690,000 and 1,250,000 cubic feet. Production was from the Oriskany and Onondaga formations. The only well drilled in the Potter-Tioga field was in a depleted Oriskany pool to be used for storage.

A test in Beaver Township, Crawford County, had a daily initial production of 190,000 cubic feet from the Oriskany sand and a rock pressure of 650 pounds per square inch. A second test in the same area failed to find production.

Oriskany tests in Beaver, McKean, Venango, and Warren Counties found salt water only. A well in Elk County encountered no sand at the Oriskany horizon and was being deepened. A test planned for the Medina sand in Crawford County was abandoned before reaching the formation because of mechanical difficulties.

Two wells drilled to the Trenton lime found salt water. One in Mercer County was abandoned at 711 feet, the other in Butler County at 1,241 feet. A small show of gas was found in the Ordovician lime and dolomite, but a large volume of salt water was encountered 44 feet below the Trenton horizon.

A test in Butler County that was abandoned at 10,096 feet sets a new record for depth in the Appalachian area. It is believed to be

the deepest hole ever drilled with cable tools. Several strings of tools were lost when they encountered high-pressure gas pockets, but in spite of difficulties the work was completed in 16 months. Indications are that a number of exploratory wells will be drilled in the deep formations during 1945.

Production from the shallow fields in Pennsylvania failed to meet peak-load demands in 1944, although maximum withdrawals were made. It is estimated that output was about the same as in 1943. Figures of Oriskany production are not available. The Potter-Tioga field is no longer an important source of gas. There is no record of the output of the Fayette County field.

South Dakota.—According to J. R. Schwabrow, assistant superintendent, Geological Survey, United States Department of the Interior, Casper, Wyo., in 1944, one small gas well was drilled in South Dakota near Pierre.

State production totaled 7,332 thousand cubic feet, a 10-percent increase over the 6,655 thousand reported in 1943. The gas is used for heating the State capitol and for domestic purposes in Pierre.

Texas.—The marketed production of the natural gas in Texas is estimated to have increased 10 percent in 1944 over 1943 to about 1,460 billion cubic feet as all types of use within and outside the State continued to expand. The capacity of several major gas pipeline systems was increased during the year, and the completion in November of the new 26-inch line from South Texas to West Virginia provided a new outlet for 200 million cubic feet per day.

The continued development of the Carthage gas field in Panola County proved a gas reserve of the first magnitude. By early 1945 the productive area covered about 300 square miles, and estimated reserves exceeded 10 trillion cubic feet of gas and an ultimate condensate recovery of at least 20 million barrels. There are four important productive zones in the field, all with relatively high pressures—the Hill zone 2,100 pounds, Upper Pettit 2,600, Lower Pettit 2,700, and Travis Peak, 2,400.

Drilling at Carthage in 1944 included about 20 wells, many of which were dually completed. The productive area was extended several miles outward from the vicinity of Carthage which is now near the center of the proved area. The limits of the field are not yet defined.

Large-capacity pipe lines are already located in and near the field, and an additional line is projected to run northeast to supplement the declining capacity of the old Monroe (La.) gas field. Three natural-gasoline plants to process the gas are under construction.

Preparations for a large gas-repressuring operation in the West Pampa oil pool, Gray County, were progressing at the end of 1944. A cooperative agreement among 26 companies, covering 950 oil wells on 11,500 productive acres, was executed to govern joint activities. The project is expected to increase oil recovery about 40 million barrels above current production methods.

According to the Oil and Gas Journal, gas-well completions in 1944 totaled 268 — a gain of 91 percent over 1943. Almost half of the completions were in the Gulf Coast district, where active development of condensate fields for cycling continued and drilling for gas was stimulated by the prospect of a large, new market through the 24-

inch line mentioned above. Seventeen gas discoveries were reported in the Coastal district, of which at least 7 were of the condensate type.

Gas development in the Panhandle accelerated in 1944 as indicated by 47 gas-well completions compared with 30 in 1943. Three gas discoveries were listed for the district.

In other Texas districts, gas completions were as follows: South 32 (including 6 discoveries), East 29 (5 discoveries), West 15 (2 discoveries), North and West Central 15, South Central 2.

Early in 1945 the Texas Railroad Commission appointed an engineering committee to make a field-by-field study of gas waste to guide formulation of conservation policy. A preliminary survey indicated that 60 percent of the gas wasted to the atmosphere was being produced from 52 fields.

Utah.—J. R. Schwabrow, acting superintendent, Geological Survey, United States Department of the Interior, Casper, Wyo., states that there were no new natural-gas developments in Utah during 1944.

Gross production from Clay Basin, the only commercial gas field in the State, totaled 6,223 million cubic feet—20 million was used in the field and 6,203 marketed. In 1943 gross production was 3,893 million cubic feet—18 million was used in the field, 10 million lost, and 3,865 marketed.

Carbon dioxide gas amounting to 166 million cubic feet was produced from the Farnum dome compared with 161 million in 1943. The gas is used in the manufacture of dry ice.

Virginia.—There were no drilling operations in Virginia in 1944, according to William M. McGill, assistant State geologist, Virginia Conservation Division.

The well in Lee County, which was reported as drilled to a depth of 3,252 feet and capped in 1943, was not used in 1944. It is expected that it will be deepened early in 1945.

Production in Virginia comes from six wells in the Early Grove field in Scott and Washington Counties. It is found in the Little Valley limestone (Maccrady formation) of Mississippian age. One well was shut down for several months during the year for recasing. This was the primary cause of a decrease in output from 84,000,000 cubic feet in 1943 to 57,340,000 in 1944.

West Virginia.—David B. Reger, consulting geologist, Morgantown, W. Va., has furnished information relative to natural-gas operations in West Virginia in 1944.

Leasing of wildcat acreage was unusually active during the year. Possibly 6,000,000 acres were under lease in the State. Of the 40 wildcats drilled 25 discovered gas. At least 4 new gas pools were located, and new pools or wide extensions of old pools were indicated. Approximately 34,000 acres were proved. Comparative figures for 1943 were 42 wildcats drilled, of which 19 were gas wells, and 39,000 acres proved.

In all, 577 gas wells were drilled, more than in any previous year since 1937 and 102 more than the 1943 record. The daily open flow of the new wells totaled 305,372,000 cubic feet and averaged 529,241 cubic feet per well. New wells in 1943 had 454,735,000 cubic feet of daily open-flow capacity and averaged 957,337 cubic feet per well. The 45-percent decline in the average production per well in 1944 is

attributable to the decreased number of Oriskany wells, which are usually large.

Added daily production of 12,327,000 cubic feet of gas was found by deepening 107 old wells. Fifty-seven old wells were deepened in 1943, adding 11,484,000 cubic feet to daily production.

The decline in drilling to the deep Oriskany sand that characterized 1943 was continued in 1944. Forty tests were drilled, of which 20 (19 in the Charleston field) had commercial gas compared with 105 in 1943, of which 80 (all in the Charleston field) had commercial gas. One well with heavy rock pressure, the deepest of the year, was completed at 8,036 feet in Tucker County. It may make gas available from the closed dome of the large Blackwater anticline. Tests in Boone, Hancock, Preston, Putnam, Raleigh, Wayne, and Wood Counties were unsuccessful.

Two of three wells drilled to the Newburg sand were productive. Both were in Wayne County; one extended the Butler producing area $1\frac{1}{2}$ miles.

In southern West Virginia extensions to known pools producing from the Big Lime were made in Kanawha, Lincoln, Putnam, Raleigh, Wayne, and Wyoming Counties, and new pools were opened in Logan and Nicholas Counties. Little drilling has been done in the Big Lime, but it is hoped that upon development it will add materially to the State production.

Kanawha and Lincoln Counties led in the number of gas completions in 1944. Jackson County, first in rank in 1943 with 61 completions, had only 14 in 1944. Counties of greatest activity in 1944 were: Kanawha 74, Lincoln 74, Boone 53, Wayne 45, Clay 37, Gilmer 36, Upshur 33, and Calhoun 31.

The practice of storing gas in pools near trunk lines and areas of heavy demand was continued in 1944. Texas gas was brought to the State for the first time when the Tennessee Gas & Transmission Co. began delivering 200,000,000 cubic feet a day at the end of October. Of this, 50,000,000 cubic feet were sent to Ohio and the remainder to Pennsylvania and New York to supplement the Appalachian production, which has proved inadequate to meet industrial war demands.

Natural-gas production in West Virginia is estimated at 200,000 million cubic feet in 1944, an 11-percent decline from the 223,787 million reported for 1943. There were 14,720 gas wells operated, 411 more than in 1943. The average daily production per well was 37,225 cubic feet in 1944, a decline of 15 percent from the 43,848 reported in 1943.

Wyoming.—Seven gas wells were drilled in Wyoming in 1944, two at South Baxter, and one each at Bell Springs, East Mahoney, Powder River, Garland, and Little Grass Creek. The completions in Bell Springs, Powder River, and Little Grass Creek discovered new gas pools in the deeper zones. They were tests that failed to find oil in the deep Tensleep or Madison formations and were plugged back to gas-producing sands. The East Mahoney well was also a deep hole that was plugged back. Deep tests in the Big Sand Draw, Golden Eagle, Little Buffalo Basin, and South Elk Basin areas also found gas that may later be used either commercially or in the development of the oil pools.

The Little Grass Creek and Powder River fields were added to production in 1944, making a total of 35 that produce gas commer-

cially. Areas having the largest marketed production were Baxter Basin, 9,453 million cubic feet; Big Sand Draw, 6,456 million; Salt Creek, 3,405 million; Garland, 3,159 million; and Lance Creek, 2,608 million. These figures represent 70 percent of the total marketed production. Garland, with an increase of 1,175 million cubic feet in output, displaced Little Buffalo Basin among the top-ranking fields.

Natural-gasoline plants processed 22,985 million cubic feet of gas in 1944 to produce 34,480 thousand gallons of gasoline, a 1-percent decrease in total gas treated and a 9-percent increase in gasoline produced compared with the 1943 figures.

The Lance Creek, Salt Creek, and Big Sand Draw areas continued to be the main sources of gas for processing and furnished 94 percent of the total compared with 96 percent in 1943. Normal butane and isobutane were also recovered at plants in the Salt Creek field and butane in the Lance Creek, Medicine Bow, and Rock River fields.

Gross production in Wyoming totaled 51,602 million cubic feet in 1944—6 percent over the 1943 record of 48,476 million cubic feet. Repressuring accounted for 12,243 million, field use for 1,348 million, and losses for 2,012 million. Comparable figures for 1943 are: Repressuring 13,992 million, field use 1,090 million, and losses 1,474 million. The 36-percent increase in losses in 1944 was partly due to a greater amount of sour gas produced with oil from the Tensleep sand at Elk Basin. Field use increased 24 percent. The same eight fields had repressuring operations as in 1943. Lance Creek with 375 million cubic feet less and Salt Creek with 1,648 million less gas returned to oil reservoirs were the primary cause of a 13-percent decrease from the 1943 record. In all other fields repressuring operations increased, except in the Lost Soldier field, where 214 million cubic feet less gas was injected.

Marketed production registered a 13-percent gain and totaled 35,999 million cubic feet in 1944 compared with 31,920 million in 1943.

The above information was taken from a report from J. R. Schwabrow, acting superintendent, Geological Survey, United States Department of the Interior.

CONSUMPTION

The year 1943 was a critical one for the natural-gas industry. Increased demands by war industries and by concentrated groups of domestic and commercial consumers near such industries, together with difficulties in procurement of manpower and materials, posed many problems for distributors. Shortages occurred in some areas, and restrictions were placed upon some industrial uses of gas during periods of peak load, but on the whole the natural-gas business met the demands made upon it for essential service.

Total consumption was 3,403,479 million cubic feet—12 percent over the 3,044,773 million reported in 1942. The expansion that predominated in domestic and commercial markets in 1942 shifted to the industrial classes in 1943. Domestic and commercial consumption increased 8 percent and industrial consumption 13 percent over 1942 compared with respective gains of 16 and 7 percent in 1942 over 1941.

Natural gas consumed in the United States, 1939-43

Year	Domestic and commercial consumption							
	Consumers (thousands) ¹			Billions of cubic feet			Average number of M cubic feet used per domestic and commercial consumer	Average value at points of consumption per M cubic feet (cents)
	Domes- tic	Com- mercial	Total	Domes- tic	Com- mercial	Total		
1939.....	8,888	715	9,603	391	119	510	53.1	67.9
1940.....	9,245	741	9,986	444	134	578	57.9	65.7
1941.....	9,730	767	10,497	442	145	587	55.9	65.9
1942.....	10,135	779	10,914	498	184	682	62.5	63.4
1943.....	10,354	811	11,165	529	205	734	65.8	62.4

Year	Industrial consumption							Total consumption		Elec- tric public- utility power plants (bil- lions of cubic feet) ³
	Billions of cubic feet						Aver- age value at points of con- sump- tion per M cubic feet (cents)	Total con- sump- tion per M cubic feet (cents)	Average value at points of con- sump- tion per M cubic feet (cents)	
	Field	Car- bon- black manu- fac- ture	Petro- leum refin- eries	Port- land- cement plants ²	Other indus- trial	Total indus- trial				
1939.....	681	347	98	40	798	1,964	9.6	2,474	21.6	191
1940.....	712	369	128	42	826	2,077	9.5	2,655	21.7	183
1941.....	686	365	148	54	965	2,218	10.5	2,805	22.1	205
1942.....	721	336	202	64	1,040	2,363	10.9	3,045	22.7	239
1943.....	781	315	244	52	1,277	2,669	11.3	3,403	22.3	301

¹ Includes consumers served with mixed gas.² Chapters on Cement in Minerals Yearbook.³ Federal Power Commission. Figures include gas other than natural, impossible to segregate; therefore shown separately from main table.

Texas, California, Louisiana, and Oklahoma maintained the same rank as in 1942 as the largest consuming States, with gains of 15, 13, 14 and 4 percent, respectively. These States possess a plentiful supply of gas which, reflected in low-average wellhead values except in California, stimulates industrial utilization. In Texas and Louisiana in 1943, industrial consumption (which includes large oil-field and carbon-black components) was 93 and 92 percent, respectively, of total State consumption. On a regional basis increases in consumption of natural gas in 1943 over 1942 were as follows: Southwest 14 percent, California 13 percent, Southeast 9, North Central 8, Northeastern 8, and Rocky Mountain 5.

The average value of natural gas at points of consumption was 22.3 cents in 1943 compared with 22.7 cents in 1942. Slight gains in the value of gas used for field purposes and for carbon-black manufacture failed to offset decreases in the average value of gas used for domestic, commercial, and miscellaneous industrial purposes.

Natural gas consumed in the United States, 1939-43, by States, in millions of cubic feet

State	1939	1940	1941	1942	1943
Alabama.....	20,093	23,461	32,023	36,287	30,123
Arizona.....	16,643	18,002	18,213	24,783	24,048
Arkansas.....	35,673	39,719	46,933	54,069	82,825
California.....	348,361	351,950	374,905	403,968	457,757
Colorado.....	21,978	22,111	26,574	28,860	31,424
District of Columbia.....	4,069	4,686	5,124	5,966	6,754
Florida.....	1,658	1,481	2,378	3,303	4,033
Georgia.....	16,296	20,551	23,975	31,996	33,280
Illinois.....	77,134	88,088	98,634	110,941	122,340
Indiana.....	30,795	29,214	29,989	37,642	39,227
Iowa.....	21,732	23,460	24,589	29,481	28,667
Kansas.....	85,865	96,772	109,059	121,354	129,173
Kentucky.....	16,563	18,881	20,170	21,382	23,409
Louisiana.....	164,667	185,089	222,025	253,894	290,651
Maryland.....	4,907	5,855	6,587	7,438	2,395
Michigan.....	27,316	32,790	37,290	42,202	53,010
Minnesota.....	17,262	19,904	22,672	29,116	33,501
Mississippi.....	14,207	17,657	20,813	26,444	30,113
Missouri.....	47,157	53,141	58,138	61,354	59,577
Montana.....	19,765	22,328	24,751	27,773	28,815
Nebraska.....	19,654	20,087	19,205	20,730	30,462
New Mexico.....	38,981	40,198	39,138	45,822	52,126
New York.....	46,877	27,250	25,394	27,150	27,787
North Dakota.....	1,607	1,725	1,741	1,904	2,030
Ohio.....	114,720	129,856	136,251	144,325	162,371
Oklahoma.....	231,005	230,806	209,395	220,991	230,423
Pennsylvania.....	109,746	121,230	139,492	143,187	159,004
South Dakota.....	5,712	6,454	6,580	7,611	7,483
Tennessee.....	* 15,558	16,819	22,495	22,806	24,252
Texas.....	796,561	874,284	875,620	917,657	1,059,329
Utah.....	13,172	14,802	16,667	18,920	20,303
Virginia.....	* 788	963	1,166	1,418	1,610
Washington.....	63	36	1	.....	.....
West Virginia.....	69,394	77,540	88,597	93,365	94,315
Wyoming.....	17,786	17,459	18,618	20,634	20,842
Total United States.....	2,473,765	2,654,659	2,805,192	3,044,773	3,403,479

* Includes natural gas piped from Canada.

* Small amount of gas consumed in Tennessee included with Virginia; separate figures not available.

Treated for natural gasoline and other light products.—Natural gas processed at natural-gasoline and cycle plants increased 6 percent to 3,028,000 million cubic feet in 1943, from 2,864,400 million in 1942. The ratio to total consumption was 89 percent, the lowest since 1939 when 87 was recorded. Gas processed in Louisiana decreased 4 percent following a 29-percent increase in 1942. Decreases were also recorded in Michigan, New Mexico, Ohio, Oklahoma, and Wyoming. Texas, with an 11-percent gain, accounted for 50 percent of the total gas processed in the United States. Arkansas made the largest proportional gain—71 percent over the 1942 record; and California reported a small increase, the first since 1938. The average yield of natural gasoline, including cycle products, was 0.92 gallon per thousand cubic feet of gas processed compared with 0.95 gallon in 1942. The average yield of all light products remained unchanged from 1942 at 1.22 gallons per thousand cubic feet.

Natural gas treated at natural-gasoline and cycle plants in the United States, 1939-43, by States, in millions of cubic feet

State	1939	1940	1941	1942	1943
Arkansas	19,171	26,584	19,906	25,365	43,309
California	377,041	375,407	371,350	345,191	349,383
Colorado	130	142	134	25	.....
Illinois	2,440	12,716	23,732	25,722	32,200
Kansas	141,945	150,963	176,088	179,710	196,043
Kentucky	36,817	39,662	38,062	35,408	46,149
Louisiana	114,960	145,234	191,194	247,370	236,286
Michigan	1,019	1,414	3,581	1,418	835
Montana	8,116	9,528	10,386	11,728	11,950
New Mexico	97,010	101,213	105,161	108,911	94,194
New York	65	40	5	4	4
Ohio	32,703	38,547	37,546	39,851	39,106
Oklahoma	219,755	219,255	200,319	202,653	188,029
Pennsylvania	28,662	40,161	43,704	46,603	53,616
Texas	914,701	1,123,236	1,325,471	1,372,563	1,520,043
West Virginia	140,982	168,206	195,093	197,643	198,636
Wyoming	16,483	19,092	21,568	24,235	18,217
Ratio to total consumption	2,150,000 87	2,471,400 93	2,763,300 99	2,864,400 94	3,028,000 89

Domestic and commercial.—The use of gas for domestic and commercial purposes has grown steadily since 1938 and in 1943 gained 8 percent over the 1942 record.

Domestic consumption increased 6 percent from 498,537 million cubic feet valued at \$352,520,000 in 1942 to 529,444 million cubic feet valued at \$370,558,000 in 1943. California, Colorado, and Wyoming were the only States reporting decreases. Commercial consumption totaled 204,793 million cubic feet valued at \$87,648,000 in 1943, compared with 183,603 million cubic feet valued at \$80,189,000 in 1942—a 12-percent increase in volume. Gains were made in all States except Kansas, Minnesota, and Missouri. There were 10,353,870 domestic consumers in 1943, 219,100 over the 1942 figure. The apparent decline in the number of domestic consumers in New York was caused by the transfer of a large group of meters from mixed gas to manufactured gas. All other States except Georgia and Pennsylvania recorded increases. There were 811,090 commercial consumers in 1943, compared with 778,830 in 1942. Twelve States reported fewer commercial consumers in 1943.

Domestic consumers paid an average of 70 cents per thousand cubic feet in 1943, 0.7 cent less than in 1942. Commercial consumers paid 0.9 cent less, or 42.8 cents per thousand cubic feet.

Consumption per domestic consumer averaged 51,135 cubic feet for the year, compared with 49,191 in 1942.

Domestic and commercial consumption of natural gas in the United States in 1943, by States¹

State	Domestic			Commercial			Total		
	Consumers	M cubic feet	Value at points of consumption		Consumers	M cubic feet	Value at points of consumption	Consumers	M cubic feet
			Total	Average (cents)			Total		
Alabama.....	43,280	2,786,000	\$2,534,000	91.0	4,510	1,275,000	\$703,000	55.1	4,061,000
Arizona.....	46,520	1,989,000	2,074,000	101.3	4,910	2,099,000	1,983,000	32.2	4,088,000
Arkansas.....	86,040	7,786,000	2,176,000	48.3	13,980	4,068,000	1,840,000	26.2	4,088,000
California.....	1,864,470	95,617,000	6,103,000	64.5	144,860	45,921,000	17,863,000	40.9	137,268,000
Colorado.....	1,08,960	7,464,000	3,822,000	98.5	194,860	4,336,000	1,493,000	40.9	10,940,000
District of Columbia.....				(^c)	(^c)			(^c)	
Florida.....	3,730	571,000	501,000	133.9	(^c) 620	128,000	74,000	77.8	570,000
Georgia.....	98,330	6,527,000	5,547,000	131.0	5,430	5,430,000	1,808,000	33.1	12,325,000
Illinois.....	1,330,680	22,373,000	27,117,000	131.0	67,710	6,290,000	4,794,000	73.6	28,672,000
Indiana.....	216,680	5,693,000	4,888,000	130.3	11,540	2,644,000	1,394,000	60.7	7,037,000
Iowa.....	245,710	7,735,000	5,311,000	92.8	12,120	2,364,000	1,324,000	57.7	9,099,000
Kansas.....	242,130	22,358,000	12,890,000	92.8	27,200	10,425,000	3,213,000	30.9	32,823,000
Kentucky.....	182,070	10,777,000	6,202,000	87.9	17,420	3,322,000	2,090,000	48.1	14,099,000
Louisiana.....	228,610	12,936,000	8,158,000	67.9	27,870	10,580,000	3,080,000	39.1	23,538,000
Maryland.....	260,380	17,930,000	6,159,000	63.7	32,010	1,428,000	1,942,000	68.0	19,358,000
Michigan.....	804,650	29,370,000	20,446,000	100.3	32,010	5,092,000	4,171,000	81.9	34,462,000
Minnesota.....	68,740	4,660,000	6,238,000	79.5	7,780	2,622,000	1,112,000	42.9	10,436,000
Mississippi.....	167,900	7,662,000	15,158,000	82.3	29,730	3,464,000	2,028,000	58.5	10,182,000
Montana.....	47,630	7,037,000	8,516,000	46.3	4,680	4,428,000	1,297,000	29.3	21,126,000
Nebraska.....	129,480	2,700,000	4,737,000	67.3	8,780	1,981,000	1,018,000	51.4	12,000,000
New Mexico.....	33,450	2,700,000	1,867,000	67.6	8,820	2,509,000	750,000	29.9	9,018,000
New York.....	418,100	17,495,000	14,544,000	83.1	36,300	3,858,000	2,718,000	70.5	21,353,000
North Dakota.....	(^c)			(^c)				(^c)	
Ohio.....	1,265,960	76,159,000	49,357,000	64.8	115,650	15,008,000	8,483,000	56.5	91,177,000
Oklahoma.....	281,020	25,681,000	11,942,000	46.5	34,360	17,328,000	4,185,000	24.2	57,840,000
Pennsylvania.....	669,870	42,970,000	26,973,000	62.8	53,870	9,471,000	4,890,000	51.6	52,441,000
South Dakota.....	(^c)			(^c)				(^c)	
Tennessee.....	57,920	4,644,000	3,370,000	72.6	7,520	3,484,000	1,312,000	37.5	8,140,000
Texas.....	730,630	44,536,000	28,473,000	63.9	81,320	25,339,000	10,415,000	41.1	69,875,000
Utah.....	157,420	5,249,000	3,619,000	68.9	3,880	2,771,000	1,000,000	36.1	8,020,000
Virginia.....	(^c)			(^c)				(^c)	
West Virginia.....	204,600	22,530,000	8,191,000	36.4	19,180	5,473,000	1,833,000	33.5	28,003,000
Wyoming.....	24,000	3,385,000	1,662,000	50.0	3,050	2,362,000	692,000	29.3	5,747,000
Total: 1943.....	10,353,870	529,444,000	370,558,000	70.0	811,090	204,793,000	87,648,000	42.8	734,237,000
Total: 1942.....	10,134,770	496,557,000	352,520,000	70.7	778,830	183,603,000	80,186,000	43.7	682,140,000

¹ Includes natural gas used with manufactured gas.² Maryland includes District of Columbia and Virginia.³ Utah includes North Dakota and South Dakota.

Field.—Field use took 23 percent (780,986 million cubic feet) of the total consumption in 1943 compared with 24 percent (721,063 million cubic feet) in 1942. Decreases were recorded in Colorado, Kansas, Michigan, Missouri, New York, Oklahoma, and Pennsylvania. Fewer wells were drilled in 1943 than in 1942, although efforts to find new production were encouraged by the Government. Shortages of manpower and materials continued to retard drilling operations. The 8-percent increase in field consumption in 1943 is related to a 25-percent gain in the use of gas lift for recovering petroleum in a few States and to greater shrinkage at gasoline and cycle plants.

The value of gas used in the field was strengthened in 1943, but gains in volume in States having low average values kept the total average practically unchanged from the 1942 level.

Carbon-black manufacture.—Although carbon-black production in 1943 was 3 percent greater than in 1942, the industry required 6 percent less natural gas because the average yield of black increased. Rapid expansion in the production of high-yield furnace-type blacks has resulted in a gain in average yield from 1.47 pounds of carbon black per thousand cubic feet of gas burned in 1938 to 1.88 pounds in 1943. There were 315,562 million cubic feet burned in 1943 compared with 335,533 million in 1942. The gas was valued at \$4,624,000 in 1943—an increase of \$286,000 over the 1942 record.

Carbon-black producers paid an average of 1.5 cents per thousand cubic feet in 1943 and 1.3 cents in 1942. The average cost of gas at plants has increased in each year since 1938.

New pipe-line outlets that afford improved markets for gas have reduced the amount available for carbon-black operations in some areas. Two pipe lines are proposed that will bring cheap gas to plants operating below capacity in the Texas Panhandle, in order to increase the supply of carbon black to meet the urgent needs for synthetic-rubber compounding.

Petroleum refineries.—Natural gas used as fuel in petroleum refineries increased 21 percent over 1942 (from 201,670 million cubic feet in 1942 to 243,584 million in 1943). This represented 26 percent of the total refinery fuel requirements in terms of B. t. u. in 1943 compared with 24 percent in 1942, and 15 percent in 1939. Texas, California, Louisiana, and Oklahoma, in the order named, maintained the same rank as in 1942 and collectively used 91 percent of the total volume of gas. Texas requirements increased 17 percent over the 1942 record, California 34, Louisiana 16, and Oklahoma 30. Decreases were reported in Illinois, Kansas, New York, Pennsylvania, and West Virginia.

Electric public-utility power plants.—Electric public-utility power plants used 305,576 million cubic feet of gas in 1943—28 percent over the peak of 238,736 million recorded in 1942. A small percentage of manufactured gas is included in the figures as reported by the Federal Power Commission. Districts showing the greatest changes from the 1942 records are the East North Central, with a 47-percent decrease; the West South Central, with a 36-percent increase; and the Pacific with a 199-percent increase. The West North Central reported a small decline; all others showed gains. Texas had the largest consumption of any State—106,061 million cubic feet (41 percent over

the 1942 figure and 35 percent of the total consumed in 1943). Louisiana, with a 17-percent gain to 41,268 million cubic feet, ranked second, California third with 36,049 million cubic feet, and Oklahoma fourth with a 45-percent gain to 24,040 million cubic feet. Decreases were reported in 10 States.

Since 1933 the utilization of gas for generating electricity has increased 198 percent; the total production of electricity, 161 percent; and the production of electricity from all fuels, 190 percent.

Portland-cement plants.—Natural gas consumed at portland-cement plants in 1943 fell 20 percent to a level below that of 1941, offsetting the 19-percent gain in 1942.

A total of 51,748 million cubic feet was used in 1943 compared with 64,540 million in 1942. This decrease was due to a 27-percent decline in portland-cement output in 1943 from the 1942 record.

In 1944, cement plants used only 35,588 million cubic feet of natural gas, the smallest quantity since 1935, as cement production declined 32 percent below 1943.

Other industrial.—Gas used for "other" industrial purposes, including fuel at public-utility power plants, continued the expansion that began in 1939. Consumption in 1943 was 1,277,362 million cubic feet compared with 1,039,827 million in 1942—a 23-percent gain. Increases were recorded in most States having abundant gas supplies; small decreases were reported in a number of States, some of which were effected by limitations in gas supply. The largest gains were in Texas, California, Arkansas, and Louisiana.

The average value of gas used at petroleum refineries, portland-cement plants, and for "other" industrial uses was 16.7 cents per thousand cubic feet in 1943 compared with 17.1 cents in 1942. The total value was \$262,819,000 in 1943, a gain of \$39,286,000 over the 1942 record.

Mixed gas.—The quantity of natural gas used with manufactured in 1943 was 10 percent above the 1942 figure. Gas used for domestic purposes gained 8 percent, for commercial purposes 5 percent, and for industrial purposes 20 percent. The increase in volume of industrial gas—from 18 percent of the total in 1942 to over 19 percent in 1943—contributed to the decrease in average value from 83.0 cents per thousand cubic feet in 1942 to 79.1 cents in 1943. A decline of 13.7 cents has taken place since 1939.

Natural gas used with manufactured gas totaled 84,853 million cubic feet valued at \$67,090,000 in 1943 compared with 77,259,000 million valued at \$64,093,000 in 1942. Illinois, with a 12-percent gain over 1942 requirements, and New York, despite an 8-percent decrease, maintained their rank as the two largest consumers.

There were 2,489,100 domestic and 133,130 commercial consumers in 1943 compared with 2,514,460 domestic and 138,040 commercial consumers in 1942. Although Indiana, Ohio, and Pennsylvania reported small declines, the decrease in the total number of consumers resulted primarily from the transfer of a large number of meters in New York from the mixed to the manufactured classification.

Industrial consumption of natural gas in the United States in 1943, by States and uses

State	Field (drilling, pumping, and operating gasolene-recovery plants)		Carbon-black manufacture		Fuel at petroleum refineries, electric public-utility power plants, cement plants, and other industrial					Total industrial		Fuel at electric public-utility power plants ¹
	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Value at points of consumption	M cubic feet				M cubic feet	Value at points of consumption		
					Petroleum refineries	Portland-cement plants	Other industrial	Total		Total	Average (cents)	
Alabama.....						(¹)	36,062,000	36,062,000	\$6,123,000	36,062,000	17.0	1,002,000
Arizona.....						(¹)	19,360,000	19,360,000	3,840,000	19,360,000	19.8	1,490,000
Arkansas.....	14,204,000	\$718,000			5,167,000	(¹)	51,587,000	5,253,000	9.3	70,958,000	8.4	7,880,000
California.....	124,415,000	8,274,000	(¹)	(¹)	45,603,000	13,002,000	137,469,000	196,074,000	26,723,000	320,489,000	10.9	36,049,000
Colorado.....	206,000	18,000			1,000	(¹)	20,733,000	20,734,000	2,965,000	20,940,000	14.2	3,558,000
Dist. of Columbia.....							(¹)	(¹)	(¹)	(¹)	(¹)	
Florida.....							3,654,000	3,654,000	551,000	3,654,000	15.1	
Georgia.....							20,954,000	20,954,000	3,715,000	24,669,000	17.7	12,753,000
Illinois.....	14,424,000	661,000			693,000		77,551,000	78,244,000	17,418,000	95,662,000	19.5	7,721,000
Indiana.....	339,000	27,000			804,000		30,743,000	31,547,000	9,450,000	41,000,000	29.7	3,814,000
Iowa.....						(¹)	20,598,000	20,598,000	3,232,000	23,830,000	15.7	2,658,000
Kansas.....	18,363,000	1,278,000			5,275,000	7,103,000	65,692,000	77,987,000	9,627,000	86,350,000	11.3	21,963,000
Kentucky.....	2,244,000	340,000			34,000		7,032,000	7,066,000	2,005,000	9,310,000	25.2	
Louisiana.....	88,797,000	3,363,000	(¹)	(¹)	32,767,000	(¹)	128,015,000	160,782,000	15,962,000	176,744,000	42.0	41,268,000
Maryland.....					42,000		18,051,000	18,093,000	9,389,000	27,473,000	50.8	17,000
Michigan.....	455,000	39,000					23,065,000	23,065,000	4,291,000	27,356,000	18.6	6,729,000
Minnesota.....	831,000	137,000					21,100,000	21,100,000	3,201,000	24,301,000	15.3	2,786,000
Mississippi.....	50,000	5,000					38,401,000	38,401,000	7,864,000	46,265,000	20.5	6,819,000
Missouri.....	1,638,000	89,000				(¹)	13,438,000	15,179,000	2,049,000	16,815,000	12.7	1,056,000
Montana.....					1,741,000		11,440,000	11,444,000	1,985,000	13,429,000	17.3	5,693,000
Nebraska.....					4,000	(¹)	19,374,000	21,903,000	2,627,000	24,531,000	6.4	5,250,000
New Mexico.....	24,954,000	394,000		(¹)	2,529,000		6,200,000	6,218,000	3,494,000	9,712,000	55.2	28,000
New York.....	216,000	55,000			18,000		69,456,000	69,457,000	27,120,000	96,577,000	39.0	1,382,000
North Dakota.....							57,101,000	74,362,000	7,427,000	81,789,000	5.9	24,040,000
Ohio.....	1,737,000	263,000			1,000	(¹)	99,443,000	100,053,000	32,395,000	132,448,000	32.2	12,000
Oklahoma.....	107,032,000	3,495,000		2.3	17,261,000	(¹)					(¹)	1,950,000
Pennsylvania.....	6,510,000	1,924,000			610,000	(¹)					(¹)	6,314,000
South Dakota.....							16,112,000	16,112,000	2,681,000	18,793,000	16.6	6,314,000
Tennessee.....							217,359,000	355,648,000	35,780,000	391,439,000	10.1	49,106,000
Texas.....	353,141,000	9,611,000		1.3	125,134,000	13,155,000	21,767,000	21,767,000	2,698,000	24,465,000	4.9	106,061,000
Utah.....					110,000	(¹)					(¹)	23,000
Virginia.....												

See footnotes at end of table.

Industrial consumption of natural gas in the United States in 1942, by States and uses—Continued

State	Field (drilling, pumping, and operating gasoline-recovery plants)		Carbon-black manufacture		Fuel at petroleum refineries, electric public-utility power plants, cement plants, and other industrial				Total industrial		Fuel at electric public-utility power plants ¹				
	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Value at points of consumption		M cubic feet		Value at points of consumption		M cubic feet					
				Total	Average (cents)	Petroleum refineries	Portland-cement plants	Other industrial	Total			Total	Average (cents)		
West Virginia-----	13,150,000	\$2,298,000					1,057,000		53,162,000	\$11,554,000	21.7	66,312,000	\$13,852,000	20.9	18,000
Wyoming-----	8,273,000	297,000					4,733,000		2,089,000	841,000	12.3	15,095,000	1,138,000	7.5	301,000
Miscellaneous-----			\$11,329,000	\$479,000	\$4.2			\$18,488,000							
Total: 1943-----	780,986,000	33,288,000	315,562,000	4,624,000	1.5	243,584,000	51,748,000	1,277,362,000	1,572,694,000	262,819,000	16.7	2,669,242,000	300,731,000	11.3	305,576,000
1942-----	721,063,000	30,587,000	335,533,000	4,338,000	1.3	201,670,000	64,540,000	1,039,827,000	1,306,037,000	223,535,000	17.1	2,362,633,000	288,468,000	10.9	238,736,000

¹ Federal Power Commission: Figures include gas other than natural, impossible to segregate; therefore shown separately from main table.

² Gas used in portland-cement plants included under "Miscellaneous" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.

³ Gas used in carbon-black manufacture included under "Miscellaneous" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.

⁴ Maryland includes District of Columbia and Virginia.

⁵ Utah includes North Dakota and South Dakota.

*Consumption of natural gas used with manufactured gas in the United States in 1943,
by States*

State	Domestic		Commercial		Industrial (M cubic feet)	Total	
	Consum- ers	M cubic feet	Consum- ers	M cubic feet		M cubic feet	Values at points of con- sump- tion
District of Colum- bia.....	177,620	5,180,000	9,500	859,000	715,000	6,754,000	\$4,707,000
Illinois.....	1,085,350	17,850,000	50,880	4,855,000	7,927,000	30,632,000	26,074,000
Indiana.....	49,570	1,281,000	2,220	329,000	1,353,000	2,963,000	2,680,000
Iowa.....	62,020	1,322,000	4,320	589,000	132,000	2,043,000	1,667,000
Kentucky.....	84,100	3,372,000	7,280	1,517,000	1,578,000	6,467,000	3,422,000
Maryland.....	28,450	1,044,000	660	43,000	62,000	1,149,000	941,000
Michigan.....	6,290	53,800	300	9,000	13,000	75,000	91,000
Minnesota.....	146,560	5,317,000	4,860	393,000	374,000	6,084,000	4,985,000
Missouri.....	260,060	5,040,000	10,450	838,000	782,000	6,660,000	6,464,000
Nebraska.....	58,380	1,474,000	360	72,000	184,000	1,730,000	1,025,000
New York.....	270,470	8,632,000	21,910	1,689,000	1,908,000	12,229,000	9,660,000
Ohio.....	170,250	2,396,000	16,270	874,000	956,000	4,226,000	2,624,000
Pennsylvania.....	59,380	2,205,000	2,850	380,000	478,000	3,063,000	1,999,000
Tennessee.....	1,150	19,000	90	13,000	1,000	33,000	41,000
Virginia.....	29,460	565,000	1,180	143,000	37,000	745,000	720,000
Total: 1943.....	2,489,100	55,750,000	133,130	12,603,000	16,500,000	84,853,000	67,090,000
1942.....	2,514,460	51,486,000	138,040	12,044,000	13,746,000	77,259,000	64,093,000

INTERSTATE SHIPMENTS AND EXPORTS

Interstate shipments and exports to Canada and Mexico totaled 990,457 million cubic feet in 1943—8 percent over the 1942 record. Exports to Canada were virtually the same as in 1942; those to Mexico increased 29 percent. Texas, which now ships gas to 19 States and to Mexico and has ranked first in the volume transported since 1933, gained 4 percent over 1942. Louisiana, with a 9-percent gain, ranked second and West Virginia third, with a 7-percent gain. Movements from Arkansas, Illinois, Mississippi, Montana, New York, Utah, and Virginia decreased, all are relatively small in volume. Increases were registered in all other exporting States. Kansas gained 31 percent, Kentucky 15 percent, and Oklahoma 9 percent.

Ohio consumed 4,280 million cubic feet of Texas gas in 1943 compared with 607 million in 1942. This gain was made possible by the delivery of gas, beginning in the fall of 1943, into the system of the East Ohio Gas Co. through a new connection with the Panhandle Eastern Pipe Line.

As an indication of the magnitude of interstate gas shipments relative to marketed production and consumption in the more important "exporting" States, the adjacent table is presented showing the balance of these items in 1921, 1935, and 1943.

More than half of the gas produced and marketed in West Virginia has been piped to other States for more than 2 decades, and the same is true of Kentucky for a shorter period. The large-scale movement of gas from Louisiana and Texas began in 1928-29 after the completion of major pipe lines to distant markets. It is interesting to observe that Texas consumed more natural gas than was produced and marketed within its borders until 1931, importing the deficiency from neighboring States.

MINERALS YEARBOOK, 1944

supply and demand for selected States, 1921, 1935, and 1943,
in millions of cubic feet

States and uses—Continued

State	Marketed production	Receipts from other States	Total supply and demand	Consumption within State	Deliveries to other States	Ratio of deliveries to total supply (percent)
Arkansas	15,717	15,307	31,024	26,172	4,852	15.6
California	4,820	8,847	13,667	13,667		
Colorado	58,004	2,953	60,957	53,027	7,930	13.0
Connecticut	124,058	588	124,646	100,903	23,743	19.0
Delaware	44,504	9,790	54,294	51,341	2,953	5.4
District of Columbia	174,921	2,976	177,897	81,509	96,388	54.2
Florida						
Georgia						
Idaho						
Illinois	57,125	45,019	102,144	72,806	29,338	28.7
Indiana	39,738	5,985	45,723	15,826	29,897	65.4
Iowa	249,450	4,282	253,732	151,934	101,798	40.1
Kansas	274,313	9,565	283,878	258,598	25,280	8.9
Kentucky	642,366	33,054	675,420	525,697	149,723	22.2
Louisiana	115,772	7,797	123,569	53,763	69,806	56.5
Maine						
Massachusetts						
Michigan						
Minnesota						
Mississippi						
Missouri	133,729	71,663	205,392	129,173	76,219	37.1
Montana	92,364	4,182	96,546	23,409	73,137	75.8
Nebraska	505,294	9,576	514,870	290,651	224,219	43.5
Nevada	285,045	14,974	300,019	230,423	69,596	23.2
New Hampshire	1,323,885	41,100	1,364,985	1,059,329	305,656	22.4
New Jersey	223,787	24,013	247,800	94,315	153,485	61.9
New Mexico						
New York						
North Carolina						
North Dakota						
Ohio						
Oklahoma						
Oregon						
Pennsylvania						
Rhode Island						
South Carolina						
South Dakota						
Tennessee						
Texas						
Vermont						
Virginia						
Washington						
West Virginia						
Wisconsin						
Wyoming						

includes exports to Mexico.

Interstate transportation of natural gas in 1943¹

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Arkansas		Louisiana	389,000
		Texas	1,320,000
			1,709,000
Colorado	Wyoming	Utah	5,903,000
		Wyoming	228,000
			6,131,000
Illinois	Indiana	Indiana	279,000
		Kentucky	391,000
		do	670,000
Indiana			491,000
Kansas	Missouri	Colorado	745,000
	do	Illinois	4,871,000
	Illinois	Indiana	8,668,000
	Nebraska	Iowa	9,170,000
	do	do	26,000
	South Dakota		
	Missouri		
	Illinois	Michigan	14,086,000
	Indiana		
	Ohio		
	Nebraska	Minnesota	14,640,000
	Iowa	Missouri	9,308,000
		Nebraska	9,688,000
	Nebraska	do	2,000
	Iowa		
	Missouri	Ohio	2,936,000
	Illinois		
	Indiana	Oklahoma	748,000
	Nebraska	South Dakota	1,631,000
			76,219,000

¹ Includes exports to Canada and Mexico.

Interstate transportation of natural gas in 1943 ¹—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Kentucky.....	West Virginia.....	District of Columbia.....	6,754,000
	Virginia.....		
	Maryland.....		
	West Virginia.....	Indiana.....	181,000
	Virginia.....		
	West Virginia.....	Maryland.....	915,000
	Virginia.....		
	Maryland.....	do.....	1,149,000
	District of Columbia.....		
	West Virginia.....	Ohio.....	5,522,000
	do.....	do.....	6,541,000
	do.....	Pennsylvania.....	24,269,000
	Virginia.....	do.....	4,254,000
	Maryland.....	Virginia.....	853,000
	West Virginia.....		
	do.....	do.....	713,000
	Virginia.....		
	Maryland.....	West Virginia.....	21,986,000
	District of Columbia.....		
			73,137,000
Louisiana.....	Mississippi.....	Alabama.....	37,040,000
	Mississippi.....	Arkansas.....	37,934,000
	Alabama.....	Florida.....	4,003,000
	Mississippi.....	Georgia.....	29,886,000
	Alabama.....		
	Arkansas.....	Illinois.....	22,284,000
	Missouri.....	Mississippi.....	24,546,000
	Arkansas.....	do.....	3,546,000
	do.....	Missouri.....	17,188,000
	do.....	do.....	2,908,000
	Missouri.....	Tennessee.....	24,209,000
	Illinois.....		
	Arkansas.....	Texas.....	19,116,000
	Mississippi.....		
	Arkansas.....	do.....	1,559,000
			224,219,000
Mississippi.....		Alabama.....	83,000
	Alabama.....	Florida.....	30,000
			113,000
Montana.....		North Dakota.....	2,030,000
	North Dakota.....	South Dakota.....	3,797,000
			5,827,000
New Mexico.....	Texas.....	Arizona.....	24,048,000
	New Mexico.....		
		Colorado.....	359,000
	Texas.....	Mexico.....	1,453,000
	New Mexico.....		
	Arizona.....	Texas.....	8,805,000
			34,665,000
New York.....		Canada.....	32,000
		Pennsylvania.....	693,000
			725,000
North Dakota.....	Montana.....	South Dakota.....	177,000
	North Dakota.....		
Ohio.....		West Virginia.....	143,000

¹ Includes exports to Canada and Mexico.

Balance of natural-gas supply and demand for selected States, 1921, 1935, and 1943, in millions of cubic feet

Year and State	Marketed production	Receipts from other States	Total supply and demand	Consumption within State	Deliveries to other States	Ratio of deliveries to total supply (percent)
1921						
Kansas.....	15,717	15,307	31,024	26,172	4,852	15.6
Kentucky.....	4,820	8,847	13,667	13,667	—	—
Louisiana.....	58,004	2,953	60,957	53,027	7,930	13.0
Oklahoma.....	124,058	588	124,646	100,903	23,743	19.0
Texas.....	44,504	9,790	54,294	51,341	2,953	5.4
West Virginia.....	174,921	2,976	177,897	81,509	96,388	54.2
1935						
Kansas.....	57,125	45,019	102,144	72,806	29,338	28.7
Kentucky.....	39,738	5,965	45,723	15,826	29,897	65.4
Louisiana.....	249,450	4,282	253,732	151,934	101,798	40.1
Oklahoma.....	274,313	9,565	283,878	258,598	25,280	8.9
Texas.....	642,366	33,054	675,420	525,697	149,723	22.2
West Virginia.....	115,772	7,797	123,569	53,763	69,806	56.5
1943						
Kansas.....	133,729	71,663	205,392	129,173	76,219	37.1
Kentucky.....	92,364	4,182	96,546	23,409	73,137	75.8
Louisiana.....	505,294	9,576	514,870	290,651	224,219	43.5
Oklahoma.....	285,045	14,974	300,019	230,423	69,596	23.2
Texas.....	1,323,885	41,100	1,364,985	1,059,329	305,656	22.4
West Virginia.....	223,787	24,013	247,800	94,315	153,485	61.9

¹ Includes exports to Mexico.

Interstate transportation of natural gas in 1943¹

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Arkansas.....		Louisiana.....	389,000
		Texas.....	1,320,000
			1,709,000
Colorado.....	Wyoming.....	Utah.....	5,903,000
		Wyoming.....	228,000
			6,131,000
Illinois.....	Indiana.....	Indiana.....	279,000
		Kentucky.....	391,000
			670,000
Indiana.....		do.....	491,000
Kansas.....	Missouri.....	Colorado.....	745,000
	do.....	Illinois.....	4,871,000
	Illinois.....	Indiana.....	8,668,000
	Nebraska.....	Iowa.....	9,170,000
	do.....	do.....	26,000
	South Dakota.....		
	Missouri.....	Michigan.....	14,086,000
	Illinois.....		
	Indiana.....		
	Ohio.....		
	Nebraska.....	Minnesota.....	14,640,000
	Iowa.....	Missouri.....	9,308,000
		Nebraska.....	9,983,000
	Nebraska.....	do.....	2,000
	Iowa.....		
	Missouri.....	Ohio.....	2,936,000
	Illinois.....		
	Indiana.....	Oklahoma.....	748,000
	Nebraska.....	South Dakota.....	1,631,000
			76,219,000

¹ Includes exports to Canada and Mexico.

Interstate transportation of natural gas in 1943 ¹—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Kentucky.....	West Virginia.....	District of Columbia.....	6,754,000
	Virginia.....		
	Maryland.....	Indiana.....	181,000
	West Virginia.....	Maryland.....	915,000
	Virginia.....		
	West Virginia.....	do.....	1,149,000
	Virginia.....		
	Maryland.....	Ohio.....	5,522,000
	District of Columbia.....	do.....	6,541,000
	West Virginia.....	Pennsylvania.....	24,269,000
	do.....	do.....	4,254,000
	do.....		
	Virginia.....	Virginia.....	853,000
	Maryland.....		
	West Virginia.....	do.....	713,000
	do.....		
	Virginia.....	West Virginia.....	21,986,000
	Maryland.....		
	District of Columbia.....		73,137,000
Louisiana.....	Mississippi.....	Alabama.....	37,040,000
	Mississippi.....	Arkansas.....	37,934,000
	Alabama.....	Florida.....	4,003,000
	Mississippi.....		
	Alabama.....	Georgia.....	29,886,000
	Arkansas.....	Illinois.....	22,284,000
	Missouri.....	Mississippi.....	24,546,000
	Arkansas.....	do.....	3,546,000
	do.....	Missouri.....	17,188,000
	do.....	do.....	2,908,000
	Missouri.....		
	Illinois.....	Tennessee.....	24,209,000
	Arkansas.....		
	Mississippi.....	Texas.....	19,116,000
	Arkansas.....	do.....	1,559,000
Mississippi.....			224,219,000
	Alabama.....	Alabama.....	83,000
	Alabama.....	Florida.....	30,000
Montana.....			113,000
	North Dakota.....	North Dakota.....	2,030,000
	North Dakota.....	South Dakota.....	3,797,000
New Mexico.....			5,827,000
	Texas.....	Arizona.....	24,048,000
	New Mexico.....		
	Texas.....	Colorado.....	359,000
	New Mexico.....	Mexico.....	1,453,000
	Arizona.....		
New York.....		Texas.....	8,805,000
			34,665,000
		Canada.....	32,000
North Dakota.....	Montana.....	Pennsylvania.....	693,000
	North Dakota.....		725,000
		South Dakota.....	177,000
Ohio.....		West Virginia.....	143,000

¹ Includes exports to Canada and Mexico.

Interstate transportation of natural gas in 1943 —Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet	
Oklahoma.....	Kansas.....	Arkansas.....	3,944,000	
	Missouri.....	Illinois.....	89,000	
	Kansas.....	Indiana.....	174,000	
	Missouri.....			
	Illinois.....	Iowa.....	1,942,000	
	Kansas.....			
	Nebraska.....	do.....	5,000	
	Kansas.....			
	Nebraska.....	Kansas.....	35,166,000	
	South Dakota.....	Michigan.....	295,000	
	Kansas.....			
	Missouri.....	Minnesota.....	3,084,000	
	Illinois.....			
	Indiana.....	Missouri.....	12,425,000	
	Ohio.....		1,791,000	
	Kansas.....	Nebraska.....		
	Nebraska.....	do.....	1,000	
	Iowa.....			
	Kansas.....	Ohio.....	58,000	
	Missouri.....			
	Illinois.....	South Dakota.....	322,000	
	Indiana.....			
	Kansas.....	Texas.....	10,300,000	
	Nebraska.....			
			69,596,000	
	Pennsylvania.....	New York.....	Canada.....	99,000
			New York.....	20,450,000
			Ohio.....	105,000
			West Virginia.....	1,884,000
	Texas.....	Louisiana.....	Alabama.....	3,000,000
		Mississippi.....	Arkansas.....	816,000
		Louisiana.....	do.....	5,371,000
Colorado.....			30,006,000	
New Mexico.....		Georgia.....	3,394,000	
Louisiana.....				
Mississippi.....		Illinois.....	6,370,000	
Alabama.....				
Oklahoma.....		do.....	71,776,000	
Kansas.....				
Missouri.....		Indiana.....	12,660,000	
Oklahoma.....				
Kansas.....		do.....	16,306,000	
Nebraska.....				
Iowa.....		Iowa.....	17,516,000	
Oklahoma.....				
Kansas.....		do.....	28,000	
Missouri.....				
Illinois.....		Kansas.....	36,497,000	
Oklahoma.....				
Kansas.....		Louisiana.....	9,187,000	
Nebraska.....		Mexico.....	9,626,000	
South Dakota.....				
Oklahoma.....				

¹ Includes exports to Canada and Mexico.

*Interstate transportation of natural gas in 1943*¹—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Texas—Continued.	Oklahoma.....	Michigan.....	20,561,000
	Kansas.....		
	Missouri.....		
	Illinois.....		
	Indiana.....		
	Ohio.....	do.....	62,000
	Oklahoma.....		
	Kansas.....		
	Nebraska.....		
	Iowa.....		
	Illinois.....	Minnesota.....	15,777,000
	Indiana.....		
	Oklahoma.....		
	Kansas.....		
	Nebraska.....		
	Iowa.....	Mississippi.....	673,000
	Louisiana.....		
	Oklahoma.....	Missouri.....	17,624,000
	Kansas.....		
	Oklahoma.....	Nebraska.....	7,097,000
	Kansas.....		
	Oklahoma.....	do.....	2,000
	Kansas.....		
	Nebraska.....	New Mexico.....	291,000
	Iowa.....		
	Oklahoma.....	Ohio.....	4,280,000
	Kansas.....		
	Missouri.....	Oklahoma.....	14,226,000
	Illinois.....		
	Indiana.....	South Dakota.....	1,650,000
	Oklahoma.....		
	Kansas.....	Wyoming.....	860,000
	Nebraska.....		
	New Mexico.....	do.....	305,656,000
	Colorado.....		
Utah.....		do.....	163,000
Virginia.....		Tennessee.....	33,000
West Virginia.....		Kentucky.....	3,300,000
		Maryland.....	331,000
		Ohio.....	87,871,000
	Kentucky.....	do.....	3,200,000
	Maryland.....	Pennsylvania.....	57,237,000
		do.....	1,546,000
			153,485,000
Wyoming.....		Montana.....	3,080,000
		Nebraska.....	1,581,000
		Utah.....	10,099,000
			14,760,000
			990,457,000

¹ Includes exports to Canada and Mexico.**PIPE-LINE DEVELOPMENTS**

The need for new gas-transportation facilities was increased in 1943 and 1944 by demands from important war industries coupled with limitations on supplies of other fuels. Several pipe-line projects designed to furnish new sources of gas in strategic areas were approved by the Federal Power Commission, and in 1944 a total of 3,012 miles of natural-gas lines was laid. The largest of these was a 1,265-mile line of the Tennessee Gas & Transmission Co. from Corpus Christi, Tex., to Cornwell, W. Va., to supplement insufficient supplies

of gas in the Appalachian area. The first pipe was welded January 10, 1944, and gas was flowing by October 31—a record-breaking achievement. The line comprises 1,180 miles of 24-inch and 85 miles of 20-inch pipe. The Louisville Gas & Electric Co. and subsidiaries of the Columbia Gas & Electric Corp., the Consolidated Natural Gas Co., and the National Fuel Gas Co. have arranged for deliveries from the line. The new connections built were about 135 miles of 12½-inch pipe from Hastings, W. Va., to Pew, Pa.; 57 miles of 12-inch line from Franklin to Elwood City, in western Pennsylvania; 65 miles of 16-, 20-, and 12-inch line from Marshall County, W. Va., to Washington County, Pa.; 60 miles of 8- and 12-inch line from Louisville, Ky.; and other short loops and extensions.

In response to growing markets for gas in California, the Pacific Lighting Corp. and the Southern California Gas Co. added 95 miles of 10-, 12-, and 24-inch pipe to their transportation systems in 1944. The new lines connect the Rio Vista gas field to the San Francisco Bay region and adjacent coastal territory and the La Goleta field to Ventura. They do not reach new sources of gas but make new connections with production and storage areas.

The Kansas Nebraska Natural Gas Co. built 156 miles of 8-, 12- and 18-inch line across western Kansas from the Hugoton field.

The 26-inch line of the Cities Service Transmission & Chemical Co. from Guymon to Blackwell, Okla., was completed early in 1944.

The Phillips Petroleum Co. finished 60 miles of line to serve carbon-black plants in the Texas Panhandle to enable them to operate to capacity.

The United Gas Pipe Line Co. was issued certificates by the Federal Power Commission to build a series of lines tapping new fields in southern Louisiana to supplement their available reserves.

A number of pipe-line companies built new loops to main lines and installed additional compressor horsepower to increase the capacities of their systems to deliver gas for market.

The prospects for continued expansion in gas transportation seem favorable as a number of projects are under consideration for 1945. There have been several requests for permission to extend lines into Wisconsin and Minnesota. These have been denied by the Federal Power Commission but probably will be reconsidered. The American Light & Traction Co. is planning a line from the Hugoton field in Kansas to Milwaukee and Detroit. The Consolidated Gas Corp. is contemplating a 215-mile line from Stephens County, Kans., to Wichita. The Memphis Natural Gas Co. requested authority to build 100 miles of line parallel to its present transmission system from the Monroe field in Louisiana to Memphis, Tenn. The request was denied at first, but the case was reopened in the fall of 1944, and certificates to build were granted. The Pacific Lighting Corp. is considering a line from the great Hugoton-Panhandle area of Kansas, Oklahoma, and Texas to California. Several new companies have applied for permission to make connection with the Texas-West Virginia line with the purpose of opening consuming areas to natural-gas service for the first time.

CRUDE PETROLEUM AND PETROLEUM PRODUCTS¹

By A. G. WHITE, F. S. LOTT, A. T. COUMBE, AND A. L. CLAPP

SUMMARY OUTLINE

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Refining.....	1130	Intercoastal shipments.....	1173
Aviation gasoline.....	1131		

GENERAL REVIEW

New records were set in virtually every branch of the domestic oil industry in 1944. The total demand for all oils rose to 1,879 million barrels—a gain of 207 million barrels or 12 percent. Domestic demand, including all deliveries to our armed forces at home and abroad, amounted to 1,670 million barrels, and exports and shipments to Territories were 209 million barrels.

The total demand for all oils during the 5-year period 1940–44 amounted to an annual average of 1,634 million barrels and was almost five times the average for the 5-year period 1914–18.

The outstanding change in the supply and demand for all oils in the United States in 1944 was the increase in crude-oil production to 4,584,000 barrels daily—a gain of 459,000 barrels daily compared with 1943 and a gain of 742,000 barrels daily or over 19 percent compared with 1941. A further increase is indicated in 1945, as production in the first quarter rose to 4,769,000 barrels daily.

The effect of the war on the domestic petroleum industry is shown by the changes in the major problems of supply and demand. The expansion in normal business combined with the growth in the production of war materials for domestic defense and export raised the total demand for oil products above all former records in 1941. Major readjustments in 1942 included a sharp decline in total gasoline demand and a gain in fuel-oil requirements that involved material readjustments in refinery operation and yields; a major decline in imports and a substantial gain in exports; and an acute transportation problem resulting from enemy submarine operations and the diversion of tankers from the Gulf to East coast route to war uses that resulted in a drastic curtailment of oil consumption in the Atlantic Coast

¹ Data for 1944 are preliminary; detailed statistics with final revisions will be released later.

States. Major accomplishments in 1943 included the progressive improvement in the overland transportation situation with the completion of new pipe lines and the expansion in the tank-car movements of crude oil and products to the Atlantic Coast district and the further conversion of the refining industry to produce enormous quantities of aviation gasoline and other special war products. The increase in total war requirements in 1944 so far offset the curtailment in civilian consumption that the problem of total oil supply became acute, and every effort was made to expand domestic production and to operate refineries to the limit of effective capacity.

Total demand for all oils in the United States, 1935-44

(Millions of barrels)

Year	Domestic demand	Exports	Total demand	Year	Domestic demand	Exports	Total demand
1935.....	983.7	129.0	1,112.7	1940.....	1,326.6	130.5	1,457.1
1936.....	1,092.7	132.0	1,224.7	1941.....	1,485.8	108.8	1,594.6
1937.....	1,169.7	172.8	1,342.5	1942.....	1,449.9	116.9	1,566.8
1938.....	1,137.1	193.7	1,330.8	1943.....	1,521.4	150.0	1,671.4
1939.....	1,231.1	188.9	1,420.0	1944 ¹	1,669.8	208.9	1,878.7

¹ Subject to revision.

The demand for all oils in 1945 probably will materially exceed the record levels of 1944. The culmination of the war in Europe resulted in a total demand in the first quarter of almost 502 million barrels or 5,575,000 barrels daily and exceeded demand in the same period of 1944 by about 11 percent. Although termination of the European phase of the war may reduce the total military requirements for gasoline substantially, the demand for fuel oils for naval and shipping use should continue at peak levels, and a substantial increase in civilian consumption in the United States and abroad may be expected if adequate supplies are available.

Any present estimate of the postwar demand for domestic oil is highly speculative until future policies are defined more clearly. The demand for motor fuel in the United States depends on the rate at which the supply of motor vehicles can be restored to normal. The domestic demand for heavy fuel oils is closely related to the index of total industrial activity. The position of the United States in the international oil market depends on its ability to maintain domestic crude production; on recovery of oil markets and restoration of production and refinery facilities in Europe; and on expansion of oil production in the Caribbean and Persian Gulf areas and restoration of the oil industry in the East Indies.

The principal changes in the supply of all oils in 1944 included a gain of 172 million barrels in the production of crude petroleum, an increase of 12 million barrels in the output of natural gasoline and cycle plants, a rise of 29 million barrels in total imports, and withdrawal of 6 million barrels from stocks. The record production of crude petroleum totaled 1,688 million barrels. The largest gain was 154 million barrels for Texas, and the production of that State rose from 39.5 percent of the national total in 1943 to 44.6 percent in 1944. California production increased almost 28 million barrels and Louisiana production about 6 million. The largest declines in production were 7 million barrels for Kansas and 5 million for Illinois. The increase in total imports of all oils represented a gain of 31 million barrels in crude imports and a decline of 2 million barrels for refined

products. The 6-million-barrels decline in the stocks of all oils represented a decrease of 22 million barrels in crude stocks and a gain of 16 million barrels in stocks of refined oils.

Salient statistics of crude petroleum, refined products, and natural gasoline in the United States, 1940-44

	1940	1941	1942	1943	1944 ¹
Crude petroleum:					
Domestic production.....thousands of barrels ²	1,353,214	1,402,228	1,386,645	1,505,613	1,677,753
World production.....do.	2,144,050	2,221,230	2,061,429	2,233,549	2,616,709
United States proportion of world production percent.....	63	63	67	67	64
Imports ³ thousands of barrels ²	42,662	50,606	12,297	13,833	44,805
Exports.....do.	41,496	33,238	33,834	41,342	34,238
Stocks, end of period:					
Gasoline bearing crude.....do.	264,709	247,499	234,889	{ 243,506 242,132 }	220,862
California heavy crude.....do.	11,906	10,179	10,865	{ 8,289 7,272 }	6,107
Runs to stills.....do.	1,294,162	1,409,192	1,334,103	1,429,738	1,665,684
Total value of domestic production at wells thousands of dollars.....	1,385,440	1,602,000	1,643,470	1,809,020	2,030,500
Average price per barrel at wells.....	\$1.02	\$1.14	\$1.19	\$1.20	\$1.21
Total producing oil wells in the United States, Dec. 31.....	389,010	399,960	404,840	407,170	(?)
Total oil wells completed in the United States during year.....	19,125	19,195	10,524	9,717	13,029
Refined products:					
Imports ⁴ thousands of barrels ²	41,089	46,536	23,669	49,579	47,451
Exports ⁴ do.	78,970	75,592	83,073	108,615	174,673
Stocks, end of period.....do.	280,958	{ 290,375 294,310 }	247,554	229,362	245,868
Output of motor fuel.....do.	616,695	701,294	608,900	608,180	743,484
Yield of gasoline.....percent.....	43.1	44.2	39.8	37.1	39.4
Completed refineries, end of year.....	556	522	471	452	(?)
Daily crude oil capacity of refineries thousands of barrels ²	4,719	4,957	4,902	5,093	(?)
Average dealer's net price (excluding tax) of gasoline in 50 United States cities.cents per gallon ⁵	9.08	9.49	10.44	10.45	10.49
Natural gasoline:					
Production.....thousands of barrels ²	55,700	80,855	83,322	87,716	100,046
Stocks, end of period.....do.	5,704	{ 4,275 4,437 }	4,632	4,541	4,252

¹ Subject to revision.

² 42 gallons to the barrel.

³ As reported to Bureau of Mines.

⁴ U. S. Department of Commerce; exports include shipments to noncontiguous Territories.

⁵ For comparison with succeeding year.

⁶ Estimated.

⁷ Figures not available.

⁸ American Petroleum Institute.

The problem of transportation to supply the increasing demand for oil in the Pacific war area resulted in a substantial increase in California production and further withdrawals from storage. Crude production rose from 284 million barrels in 1943 to a new record of 312 million barrels in 1944. There was a further decline of over 11 million barrels in the stocks of all oils compared with declines of 27 million barrels in 1943 and 12 million in 1942. Steps were taken to expand the production of crude oil from naval reserves and to move West Texas crude by tank car for refining in California.

With termination of the war in Europe, the problem of oil supply in the Pacific will assume major importance and involve a maximum use of available tankers for the transport of oil from Gulf Coast and Caribbean sources. Although the war demand for gasoline may have passed the peak the supply of fuel oils for naval and shipping uses will be of even greater importance.

The gain of 207 million barrels in the total demand for all oils in 1944 represented increases of 117 million barrels for motor fuel, 43 million for residual fuel oil, 20 million for distillate fuel oil, 3 million for kerosene, 1 million for lubricating oils, and 23 million for all other oils.

Supply and demand of all oils in the United States, 1943-44, by months
 [Thousands of barrels, including wax, coke, asphalt, and still gas]

	1943												1942 (total)
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
New supply:													
Domestic production:													
Crude petroleum.....	117,372	108,487	121,648	119,100	123,957	120,111	127,629	130,796	130,564	136,827	133,824	135,288	1,505,613
Natural gasoline.....	7,153	6,632	7,262	7,071	7,182	6,931	7,280	7,384	7,494	7,827	7,679	7,791	87,716
Benzol.....	200	200	200	200	200	200	200	200	200	200	200	200	2,400
Total production.....	124,725	115,319	129,110	126,371	131,339	127,262	135,109	138,390	138,258	144,864	141,703	143,279	1,595,729
Imports:													
Crude petroleum ?.....	254	-----	138	179	72	454	122	2,036	1,568	2,797	2,740	3,473	13,823
Refined products ?.....	762	1,989	433	2,566	4,098	9,886	6,278	9,652	2,903	4,500	3,949	2,537	49,579
Total new supply, all oils.....	125,741	117,308	129,701	129,116	135,509	137,602	141,509	150,078	142,759	152,167	148,392	149,289	1,659,141
Change in stocks, all oils.....	+455	-275	+235	-3,346	-2,477	-5,911	-1,618	-1,423	+324	+5,328	+288	-1,822	-12,242
Demand:													
Total demand.....	125,286	117,583	129,466	134,462	137,986	143,513	143,127	151,501	142,405	146,839	148,104	151,111	1,671,383
Exports:													
Crude petroleum ?.....	2,017	2,416	2,469	4,155	4,707	4,325	4,932	4,011	3,441	3,370	3,415	2,084	41,342
Refined products ?.....	6,978	5,769	7,241	8,662	9,417	8,590	14,913	11,953	11,210	9,431	7,661	6,790	108,615
Domestic demand:													
Motor fuel.....	36,085	36,274	41,586	48,177	49,828	52,325	49,867	51,880	49,707	53,111	50,703	48,695	568,238
Kerosene.....	8,098	8,945	7,057	5,285	4,186	4,020	4,020	3,751	4,384	5,516	6,652	7,619	68,698
Distillate fuel oil.....	22,127	19,145	19,983	15,627	17,137	15,628	13,177	16,525	15,100	14,781	19,482	22,065	208,110
Residual fuel oil.....	34,068	34,212	36,277	35,986	37,407	40,266	37,405	42,533	38,694	41,109	42,426	45,915	467,008
Lubricating oil.....	1,401	2,156	2,675	2,758	2,824	2,708	2,540	2,945	2,766	2,804	2,832	2,460	31,459
Miscellaneous.....	13,112	10,656	12,178	13,812	14,528	15,405	16,183	17,903	17,103	16,717	14,933	15,483	178,013
Total domestic demand.....	116,291	109,398	119,756	121,645	123,862	130,598	123,282	135,537	127,754	134,038	137,028	142,237	1,521,426
Stocks:													
Crude petroleum.....	234,958	237,610	242,716	243,469	244,415	241,136	239,824	237,620	236,822	239,986	243,506	243,506	234,889
Heavy crude petroleum in California.....	10,804	10,394	10,462	9,674	9,748	10,064	10,279	10,009	8,905	8,716	8,179	8,289	10,865
Natural gasoline.....	4,904	4,966	5,462	5,425	5,407	5,179	5,028	4,723	4,723	4,465	4,645	4,541	4,532
Refined products.....	247,729	245,120	239,775	234,441	230,932	228,242	227,872	229,038	231,454	234,065	231,426	229,362	247,554
Total, all oils.....	498,395	498,120	498,355	493,009	490,632	484,021	483,003	481,580	481,904	487,232	487,520	485,698	497,940

	1944 *											1943 (total)	
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
New supply:													
Domestic production:													
Crude petroleum.....	135,767	128,901	136,752	133,593	141,293	137,251	141,287	145,296	142,980	146,938	142,404	145,282	1,677,753
Natural gasoline.....	7,821	7,565	8,050	7,828	8,277	8,187	8,567	8,592	8,448	8,890	8,824	8,997	100,046
Benzol.....	200	200	200	200	200	200	200	200	200	200	200	200	2,400
Total production.....	143,788	136,666	145,002	141,621	149,770	145,638	150,054	154,088	151,637	156,028	151,428	154,479	1,780,199
Imports:													
Crude petroleum ¹	3,083	3,183	2,281	3,371	4,217	3,719	3,195	4,975	3,802	5,575	3,377	4,027	44,805
Refined products ²	3,978	3,477	4,324	4,934	5,896	4,195	4,390	3,569	3,881	2,596	2,968	3,243	47,451
Total new supply, all oils.....	150,849	143,326	151,607	149,926	159,833	153,552	157,639	162,632	159,320	164,199	157,773	161,749	1,872,455
Change in stocks, all oils.....	-3,790	-1,506	-5,649	-304	+3,334	-2,399	+1,858	+4,942	+6,099	+3,479	-2,832	-10,050	-6,218
Demand:	154,639	144,832	157,256	150,230	156,549	155,951	155,781	157,690	152,621	160,720	160,605	171,799	1,878,673
Exports:													
Crude petroleum ¹	2,488	1,904	2,105	2,891	3,136	3,642	3,516	3,387	3,354	2,990	3,001	1,824	34,238
Refined products ²	8,528	10,298	10,399	13,556	17,246	20,579	18,344	19,089	14,844	16,975	12,358	11,857	174,673
Domestic demand:													
Motor fuel.....	47,942	47,136	52,640	50,223	54,516	54,567	55,413	55,839	56,678	53,611	55,263	52,696	636,524
Kerosine.....	7,999	7,266	7,457	5,933	5,016	4,148	3,574	3,868	4,818	6,305	6,741	8,810	71,935
Distillate fuel oil.....	24,108	20,264	22,248	16,131	15,780	12,473	13,566	13,171	12,687	14,827	19,010	25,275	209,540
Residual fuel oil.....	45,762	41,607	43,567	43,979	41,913	39,580	38,933	38,612	38,296	43,796	44,425	50,327	510,797
Lubricating oil.....	2,553	2,567	2,687	2,564	2,628	2,751	2,611	2,734	2,551	2,836	3,027	2,674	32,183
Miscellaneous.....	13,259	13,790	16,153	14,953	16,314	18,211	19,824	20,390	19,393	19,380	16,780	18,336	208,783
Total domestic demand.....	143,623	132,630	144,752	133,783	136,167	131,730	133,921	134,614	134,423	140,755	145,246	158,118	1,699,762
Stocks:													
Gasoline-bearing crude in U. S.....	241,245	241,718	236,220	234,094	235,176	229,631	223,503	223,901	222,808	223,500	222,759	220,862	2,242,132
Heavy crude petroleum in California.....	6,852	6,553	6,766	6,473	6,254	6,118	6,186	6,291	6,469	6,487	6,482	6,107	67,272
Natural gasoline.....	4,295	4,245	4,242	4,213	4,436	4,477	4,425	4,211	4,141	4,160	4,334	4,252	4,541
Refined products.....	227,124	225,495	225,134	226,678	229,526	232,767	240,737	245,390	253,014	255,824	253,564	245,868	2,345,898
Total, all oils.....	479,517	478,011	472,362	472,058	475,392	472,993	474,851	479,793	486,492	489,971	487,139	477,089	4,777,089
													\$ 483,307

¹ Final figures.
² Comparable with 1942.

³ As reported to Bureau of Mines.
 Subject to revision.

⁴ U. S. Department of Commerce.
 For comparison with 1944.

The demand for motor fuel totaled 695 million barrels in 1941, declined to 624 million in 1942 and to 620 million in 1943, and rose to 737 million barrels in 1944. Data compiled by the Bureau of Public Roads indicate a decline of about 187 million barrels, or almost 30 percent, in the civilian consumption of motor fuel from 1941 to 1943. It was not until 1944 that increasing war requirements, particularly for aviation gasoline, caused total demand to exceed the peak of 1941 by 42 million barrels. The gain of 117 million barrels in total demand in 1944 compared with 1943 represented increases of 68 million barrels in domestic demand (including shipments to our armed forces abroad) and 49 million in exports. These figures primarily reflect larger military requirements at home and abroad, as due to rationing, civilian consumption showed little further change.

The total demand for residual fuel oil rose from 482 million barrels in 1943 to 525 million barrels in 1944. Compared with 1941, total demand has risen 127 million barrels. The major increase in demand has been for naval use, but railroad consumption has risen about 33 million barrels, and the gain in use to propel vessels is estimated at about 28 million barrels. A decline of about 7 million barrels in oil-company use has been offset by a rise in industry uses.

The total demand for distillate fuel oil rose from 233 million barrels in 1943 to 253 million in 1944. The 20-million-barrel gain resulted from an increase of 18 million barrels in exports and of 2 million barrels in domestic demand. The increase in total demand since 1941 has amounted to about 63 million barrels and has been due primarily to the increase in exports and in naval requirements. Consumption for heating uses declined about 11 million barrels, or 10 percent, but was offset by gains in railroad and industrial consumption.

The daily average demand for all oils in the United States was 5,133,000 barrels in 1944 compared with the prewar peak of 4,369,000 barrels daily in 1941—a gain of over 17 percent. Much of the normal seasonal fluctuation in demand has been eliminated by the steady increment in military requirements. The trend of demand in 1944 and early 1945 is reflected in the progressive changes in operations by quarters.

The total demand for all oils in the first quarter of 1944 amounted to an average of 5,019,000 barrels daily—a 21-percent gain over the corresponding period in 1943. Crude production averaged 4,411,000 barrels daily, and total crude runs to stills were 4,374,000 barrels daily. There was a reduction of almost 11 million barrels in the stocks of all oils during the quarter. The increased operations in the first quarter reflected preparations to meet the oil requirements for the major offensive in Europe.

The daily demand for all oils in the second quarter of 1944 averaged 5,085,000 barrels—a gain of about 1 percent compared with the first quarter but 11 percent more than in the second quarter of 1943. There was a substantial increase in crude production to 4,529,000 barrels daily and in total crude runs to 4,525,000 barrels daily. There was a minor increase in the stocks of all oils of less than 1 million barrels representing a decline of about 7 million barrels in crude stocks and a gain of almost 8 million in stocks of refined products.

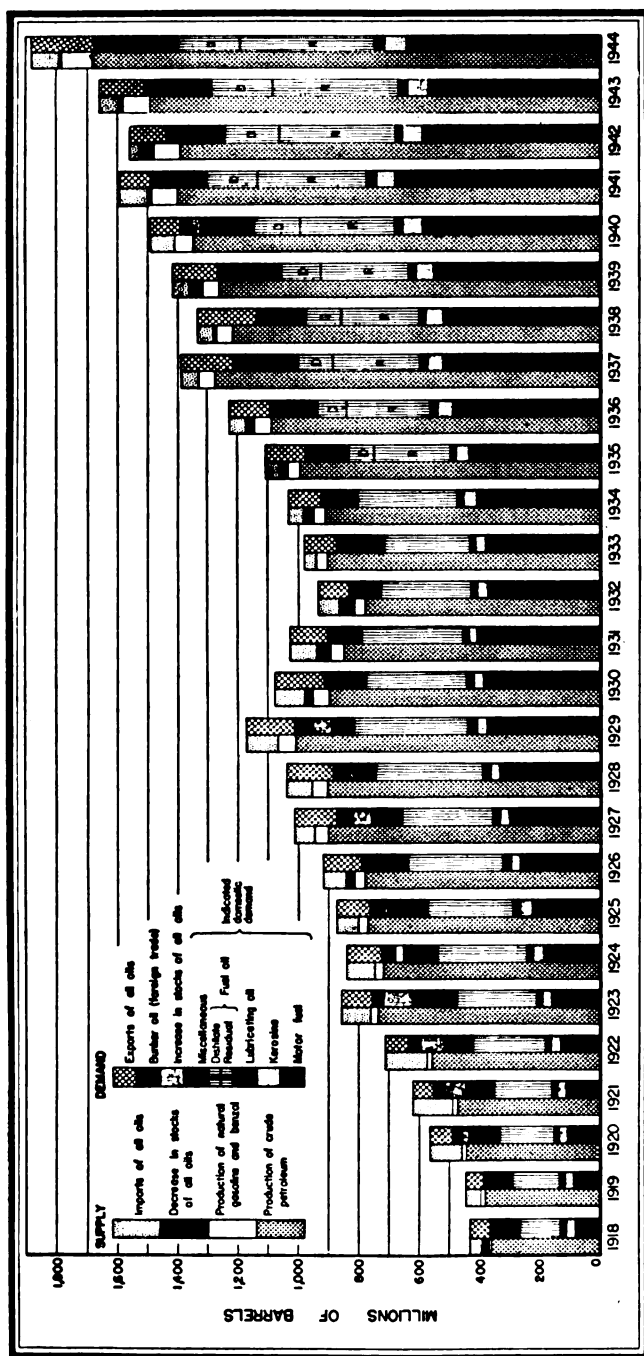


FIGURE 1.—Supply and demand of all oils in the United States, 1918-44.

Exports of all oils rose from 36 million barrels in the first quarter to 61 million in the second quarter. The increase in production and runs to stills was supplemented by a gain in total imports from 20 million barrels in the first quarter to 26 million in the second quarter.

During the third quarter of 1944 there was a minor decline in the total demand for all oils to 5,066,000 barrels daily, but demand was 7 percent above that in the same period of 1943. There was a further substantial gain in crude production to a daily average of 4,669,000 barrels, and crude runs to stills rose to 4,641,000 barrels daily. Stocks of all oils increased by over 13 million barrels during the quarter, representing a decrease in crude stocks of over 6 million barrels and a gain of 20 million barrels in stocks of refined oils. Total exports rose to a peak of 63 million barrels. The further increase in supply was essential to meet the winter demand for fuel oils and the upward trend in war requirements.

In the fourth quarter of 1944 the total demand for all oils mounted to 5,360,000 barrels daily—a 6-percent gain compared with the third quarter and almost 11 percent larger than total demand in the last quarter of 1943. There was a moderate increase in crude production to 4,724,000 barrels daily and in total runs to stills to 4,662,000 barrels daily. Stocks of all oils declined about 9 million barrels—a decrease of 2 million in crude stocks and 7 million in refined stocks.

New records were set in the first quarter of 1945. The demand for all oils averaged 5,575,000 barrels daily—a gain of 215,000 barrels daily or 4 percent compared with the fourth quarter of 1944 and an 11-percent increase compared with the first quarter of 1944. Crude production rose to 4,769,000 barrels daily and total crude runs to 4,736,000 barrels daily. Stocks of all oils declined about 20 million barrels in the first quarter. The further gain in supply was essential to meet the military requirements for termination of the war in Europe and the increasing demand in the Pacific.

RESERVES

The American Petroleum Institute Committee on Petroleum Reserves estimated reserves of crude oil in the United States on January 1, 1945, at 20,453,231,000 barrels. These reserves include only crude oil and condensate in known and proved fields recoverable under existing economic and operating conditions. Additions to reserves during 1944 totaled 2,067,500,000 barrels and represented 511,308,000 barrels from new pools discovered during the year and 1,556,192,000 barrels due to upward revisions of reserve estimates for fields discovered before 1944. The increase in total reserves amounted to about 389 million barrels during 1944 after deduction of a record production that exceeded the prewar peak of 1941 by about 276 million barrels.

The largest gains in reserves were 170 million barrels for Mississippi, 89 million for Louisiana, 83 million for Wyoming, 61 million for Oklahoma, 50 million for Texas, and 44 million for Colorado. The greatest declines in reserves were 91 million barrels for New Mexico, 44 million for Kansas, and a total of 21 million in the Appalachian States—Pennsylvania, New York, and West Virginia.

Estimates of proved oil reserves in the United States on January 1, 1939-45, by States¹

[Millions of barrels]

State	1939	1940	1941	1942	1943	1944	1945
Eastern States:							
Illinois.....	243	382	315	334	307	295	321
Indiana.....	6	14	14	23	32	31	31
Kentucky.....	38	44	41	36	35	35	41
Michigan.....	43	51	35	56	64	55	65
New York.....	41	35	65	60	54	90	86
Ohio.....	26	32	30	37	35	33	32
Pennsylvania.....	200	183	188	171	153	137	123
West Virginia.....	24	46	53	50	47	44	41
	621	787	741	767	727	720	740
Central and Southern States:							
Arkansas.....	188	320	306	295	300	297	293
Kansas.....	613	726	692	690	687	646	602
Louisiana.....	1,040	1,173	1,216	1,330	1,442	1,484	1,573
Mississippi.....	703	7	40	80	41	39	209
New Mexico.....	703	687	692	675	677	654	563
Oklahoma.....	1,162	1,063	1,002	1,036	969	909	970
Texas.....	9,448	9,768	10,624	10,976	11,546	11,325	11,375
	13,154	13,744	14,572	15,082	15,662	15,354	15,585
Mountain States:							
Colorado.....	18	20	23	23	39	45	89
Montana.....	105	94	89	86	86	108	112
Wyoming.....	261	306	305	304	371	499	582
	384	420	417	413	496	652	783
Pacific Coast States: California.....	3,189	3,532	3,291	3,323	3,196	3,337	3,344
Other States.....			4	4	2	1	1
Total United States.....	17,348	18,483	19,025	19,589	20,063	20,064	20,453

¹ From reports of Committee on Petroleum Reserves, American Petroleum Institute, of the amount of crude oil that may be extracted by present methods from fields completely developed or sufficiently explored to permit reasonably accurate calculations. The change in reserves during any year represents total new discoveries, extensions, and revisions, minus production.

TRANSPORTATION

The two major pipe lines constructed with Government funds and operated by the War Emergency Pipelines, Inc., were a major factor in solving the internal transportation problem in 1944.

The 24-inch crude line extends 1,254 miles from Longview, Tex., via Norris City, Ill., to Philadelphia and New York. From the initial delivery at Norris City in February 1943 through April 1945 about 223 million barrels of crude oil were delivered—46 million barrels to Norris City, 101 million barrels to Philadelphia, and 46 million to the New York district. During the last 11 months of this period total deliveries averaged over 317,000 barrels daily.

The 20-inch products line extends 1,475 miles from Beaumont, Tex., to New Jersey. From the initial shipment from Beaumont in January 1944 through April 1945, 84 million barrels of refined products were delivered. The peak daily throughput was 240,000 barrels. The rated capacity for gasoline is 235,000 barrels daily and 190,000 barrels daily for domestic heating oils. During culmination of the war in Europe, the line was devoted primarily to moving products for military use abroad.

The operation of these pipe lines to capacity released tank cars for essential movements between other districts. The peak of the tank car movement into the Eastern States reached about 1,000,000 barrels

daily in July 1943 and declined to about 500,000 barrels daily by the end of 1944. A substantial movement of crude oil by tank car to California refineries was inaugurated late in 1944.

The extent of the disruption of the normal movements of oil is indicated by the proposed extension of Government transportation subsidies, amounting to \$215 million, for the fiscal year 1945-46. Of this total, \$150 million is to cover possible requirements to meet extra transportation costs of crude oil or products into the Atlantic States, \$20 million for movements from the Southern and Mountain States into the North Central States, and \$45 million to cover the extra cost of moving West Texas crude oil to California by tank car.

WORLD OIL SUPPLY

The world production of crude petroleum exceeded all previous records in 1944 and increased from 2,234 million barrels in 1943 to 2,617 million in 1944. Production in 1944 was 531 million barrels greater than in 1939. In comparison with 1939, the principal gains were 413 million barrels for the United States, 58 million for Russia, 51 million for Venezuela, and 6 million for Argentina. The chief declines in production were 20 million barrels for Rumania, 22 million for the Netherlands East Indies, and 7 million for Burma.

Before the war, the United States produced about 61 percent of the total world supply of crude petroleum and by 1943 was producing 68 percent of the total. The disturbance of normal transportation routes, the diversion of tankers to war uses, and the capture by the enemy of important sources of supply in Rumania and the Netherlands East Indies led to increasing reliance on supplies from the United States to meet war requirements in Europe. Reopening of the Mediterranean route and increasing war activity in the Pacific have led to stimulation of production and expansion of refinery facilities in the Persian Gulf area and in the Caribbean. With termination of the war in Europe, these sources of supply will assume even greater importance and may, in the postwar period, change the competitive sources of world oil supply.

Current estimates of world crude-oil reserves outside the United States indicate a minimum of about 31 billion barrels, which may be increased materially by further exploration. About half of this reserve is in the Middle East, including Iraq, Iran, Bahrein Island, Saudi-Arabia, Kuwait, and Qatar. Since local consumption in these areas is of minor importance, any future expansion in production would compete in major consuming markets. Refinery capacity has been expanded materially during the war, and an increasing volume of products as well as surplus crude oil may be available for export. Transportation would be facilitated by the large increase in the world tanker fleet during the war, the possible increase in the pipe-line capacity from Iraq to Mediterranean ports, or the proposal to construct a pipe line from the Persian Gulf area to some terminus on the Mediterranean.

The most significant changes in the Caribbean area relate to Venezuela. Reserve estimates have been revised upward, production has been recently increased far above the prewar level, and refinery

capacity in the Netherlands West Indies has been expanded. A substantial increase in crude production and export may be expected in Colombia, and facilities in Peru have been increased to refine most of the production compared with the export of about two-thirds of the crude output before the war.

From the supply side, the major questions in the postwar period relate to the future rate of production in the United States, the actual increase in productive capacity in Venezuela, and the potential increase in the production in the Middle East. Other important considerations are rehabilitation of production and refinery capacity in Rumania and the Netherlands East Indies and of refinery capacity in France.

It is not easy to predict the future trends in total world demand for oil. Germany and Japan were among the large consumers of oil before the war. In the United States and northern Europe it may take several years to restore the supply of motor vehicles to normal. The degree of industrial activity and the volume of world trade will affect the consumption of fuel oils for manufacturing and bunker uses. International credit arrangements will be an important factor in the purchase of oil by countries that have other sources of fuel available.

An Anglo-American oil pact was signed on August 8, 1944, to become effective when ratified by the two Governments concerned. A great deal of discussion as to the terms and objectives of such an agreement has resulted in the United States, but no official action was taken in 1944. The original pact provided for an international commission to estimate world requirements and to make recommendations to secure adequate supplies for consuming nations and an orderly development of new reserves and production.

The significance of this pact is due primarily to the fact that the major part of the surplus production and reserves of oil outside the United States are held by United States, British, and British-Dutch oil companies. The other principal interests concerned represent the Government holdings in Russia, Mexico, and Argentina, and substantial holdings by French companies in Rumania and the Middle East.

CRUDE PETROLEUM

SUPPLY AND DEMAND

The total demand for crude petroleum in 1944 amounted to 1,745 million barrels and exceeded all previous records. The demand for domestic crude petroleum rose from 1,501 million barrels in 1943 to 1,701 million in 1944—a gain of 200 million barrels or over 13 percent. The increase in total requirements combined with an improvement in the ocean-transportation situation resulted in larger imports of crude oil, and the foreign crude run to stills rose from the low point of 12 million barrels in 1943 to 43 million in 1944. Compared with 1943, the production of domestic crude petroleum increased 172 million barrels, imports of crude gained 31 million barrels, and total stocks of crude oil were reduced by over 22 million barrels compared with an increase of 6 million barrels in 1943. The principal changes in demand were an

increase of 236 million barrels in total runs to stills, a decline of 7 million barrels in crude exports, an increase of almost 5 million barrels in transfers of crude oil to fuel oils, and a decline of 2 million barrels in other crude fuel and losses.

Supply of and demand for crude petroleum in the United States, 1940-44

[Thousands of barrels]

	1940	1941	1942	1943	1944 ¹
Production.....	1,353,214	1,402,228	1,386,645	1,505,613	1,677,753
Imports ²	42,662	50,606	12,297	13,833	44,805
Changes in stocks ³	+23,307	-18,937	-11,924	+6,041	-22,435
Total supply.....	1,372,569	1,471,771	1,410,866	1,513,405	1,744,993
Runs to stills:					
Domestic.....	1,252,364	1,358,246	1,319,507	1,417,559	1,622,514
Foreign.....	41,798	50,946	14,596	12,179	43,170
Exports.....	51,496	33,238	33,834	41,342	34,238
Transfers to fuel oil:					
Distillate.....	2,297	2,383	2,484	3,070	3,242
Residual.....	7,978	13,099	19,295	24,087	28,515
Other fuel and losses.....	16,636	13,859	21,150	15,168	13,314
Total demand.....	1,372,569	1,471,771	1,410,866	1,513,405	1,744,993

¹ Subject to revision.

² As reported to Bureau of Mines.

³ Inclusive of heavy crude in California.

PRODUCTION

General.—The record production of crude petroleum totaled 1,677,753,000 barrels in 1944—a gain of 172 million barrels or 10 percent compared with 1943. The largest gains in 1944 were 154 million barrels for Texas and 28 million barrels for California. The largest decline was 7 million barrels for Kansas.

Texas and California retained their positions as the two leading States, with 44.6 and 18.6 percent of the total national output. Louisiana ranked third in the list of producers with 7.7, Oklahoma fourth with 7.4, and Kansas fifth with 5.9 percent.

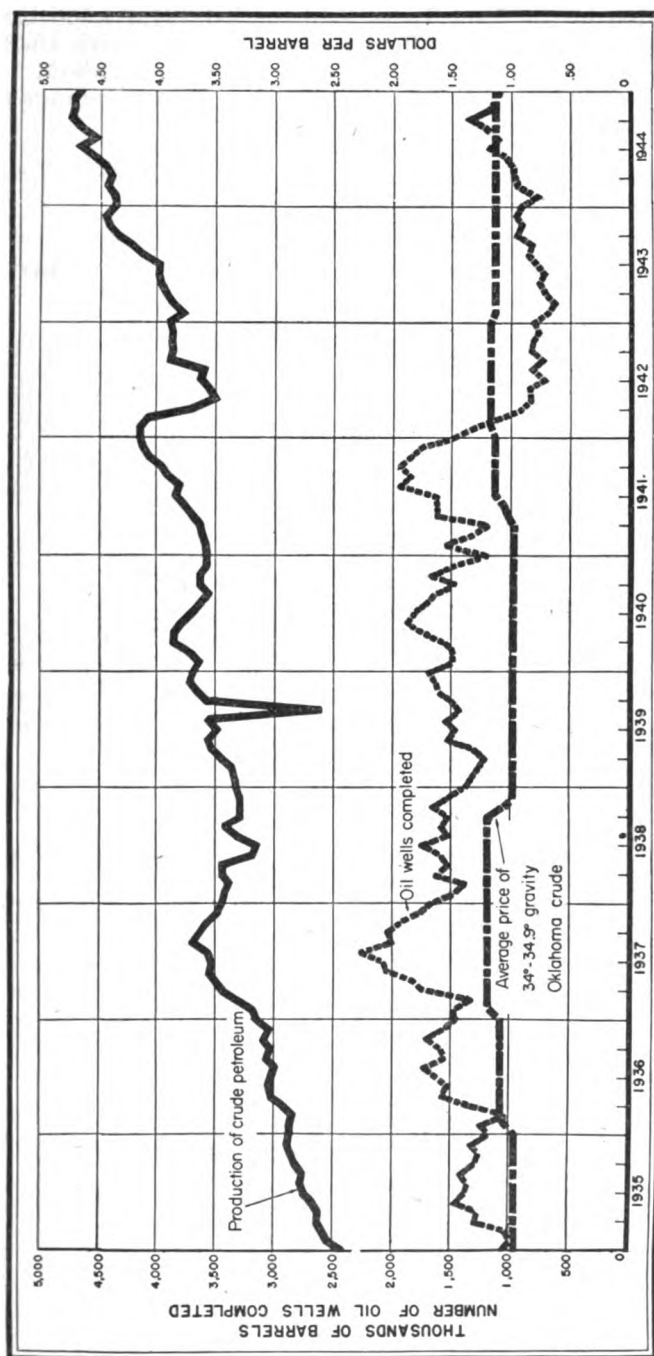


FIGURE 2.—Daily average production of crude petroleum, total number of wells completed, and average price per barrel of a selected grade of Oklahoma crude petroleum in the United States, 1935-44, by months

Production in the East Texas field totaled 134,674,000 barrels in 1944—a gain of about 6 million barrels compared with 1943. Production in the Wilmington field in California increased about 3 million barrels to 36,943,000 barrels in 1944 and rose in the Coalinga field by about 4 million barrels to 35,404,000 barrels.

Petroleum produced in the United States, 1940-44, and total, 1859-1944, by States ¹

[Thousands of barrels]

	1940	1941	1942	1943	1944 ²	1859-1944 (total)
Production:						
Arkansas.....	25,775	26,327	26,628	27,600	29,418	616,390
California.....	223,881	230,263	249,326	284,188	311,793	6,644,648
Colorado.....	1,626	2,150	2,199	2,320	2,944	49,569
Illinois.....	147,647	132,393	106,391	82,260	77,413	1,036,129
Indiana.....	4,978	7,411	6,743	5,283	5,118	155,665
Kansas.....	66,139	83,242	97,636	106,178	98,762	1,506,751
Kentucky.....	5,188	4,762	4,534	7,883	9,621	193,961
Louisiana.....	103,584	115,906	115,785	123,592	129,207	1,544,481
Michigan.....	19,753	16,359	21,754	20,768	18,490	1,222,477
Mississippi.....	4,400	15,327	28,833	18,807	16,337	83,811
Montana.....	6,728	7,526	8,074	7,916	8,627	115,635
Nebraska.....	276	1,898	1,237	635	417	4,465
New Mexico.....	39,129	39,569	31,544	38,896	39,555	424,323
New York.....	4,999	5,185	5,421	5,059	4,697	139,139
Ohio.....	3,159	3,510	3,543	3,322	2,937	601,689
Oklahoma.....	156,164	154,702	140,690	123,152	124,616	5,340,283
Pennsylvania.....	17,353	16,750	17,779	15,757	14,118	1,061,472
Texas.....	493,209	505,572	483,097	594,343	748,122	8,910,941
West Virginia.....	3,444	3,433	3,574	3,349	3,070	424,196
Wyoming.....	25,711	29,878	32,812	34,253	32,388	630,309
Other States ³	71	63	45	62	108	1,383
Total United States.....	1,353,214	1,402,228	1,386,645	1,505,613	1,677,753	29,778,657
Value at wells:						
Total (thousands of dollars).....	1,385,440	1,602,000	1,643,470	1,809,020	2,030,500	35,228,369
Average per barrel.....	\$1.02	\$1.14	\$1.19	\$1.20	\$1.21	\$1.18

¹ For detailed figures by States, 1859-1935, see Minerals Yearbook, 1937, p. 1008.

² Subject to revision.

³ Oklahoma included with Kansas in 1905 and 1906.

⁴ Includes Tennessee, 1883-1907.

⁵ Figures represent 1925-44 production only; earlier years included under "Other States."

⁶ Figures represent 1924-44 production only; earlier years included under "Other States."

⁷ Early production in New York included with Pennsylvania.

⁸ Includes Alaska, 1912-33; Arkansas, 1920; Michigan, 1900-1919; Missouri, 1889-1911, 1913-16, 1919-23, 1932-44; New Mexico, 1913, 1919-23; Tennessee, 1916-44; Utah, 1907-11, 1920, 1924-41; Florida, 1943-44; Virginia, 1943-44; Alabama, 1944.

Production of crude petroleum in the United States in 1945, by districts, States, and months

(Thousands of barrels)

CRUDE PETROLEUM AND PETROLEUM PRODUCTS

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District and State	1945 1											
	Janu-ary	Febru-ary	March	April	May	June	July	August	Septem-ber	October	Novem-ber	Decem-ber
DISTRICT												
Pennsylvania Grade.....	2,196	1,990	2,312	2,197	2,212	2,246	2,223	2,191	2,135	2,072	2,042	2,040
Other Appalachian.....	590	621	657	682	708	797	869	872	897	946	876	797
Lima-Northeastern Indiana-Michigan.....	1,803	1,644	1,815	1,805	1,872	1,728	1,768	1,760	1,739	1,708	1,653	1,653
Illinois-Southwestern Indiana.....	7,881	7,134	7,764	7,363	7,287	7,113	7,214	7,143	7,024	7,279	7,125	7,189
MID-CONTINENT:												
North Louisiana, Arkansas, and Mississippi.....	6,475	5,977	6,308	6,241	6,276	6,207	6,260	6,196	6,912	6,077	5,947	5,929
West Texas and Southeastern New Mexico.....	9,441	9,878	9,611	9,669	10,335	10,162	11,387	11,541	13,415	14,566	14,052	14,578
East Texas.....	10,159	10,163	10,163	10,704	10,638	10,130	11,554	11,492	11,523	11,521	11,490	11,396
Oklahoma, Kansas, North Texas, etc.....	31,818	29,944	33,429	32,051	33,074	32,205	33,637	34,128	33,283	34,234	33,612	33,580
Gulf Coast.....	19,749	18,243	21,831	21,538	23,728	22,561	24,753	27,380	27,268	30,112	29,319	29,322
Rocky Mountain.....	3,574	3,241	3,688	3,636	3,766	3,683	3,908	3,942	3,916	3,945	3,903	3,717
California.....	23,686	21,613	24,070	23,214	23,931	23,279	24,056	24,151	23,424	24,377	23,819	24,568
Total United States.....	117,372	108,487	121,648	119,100	123,957	120,111	127,629	130,796	130,564	136,837	133,824	135,288
STATE												
Arkansas.....	2,291	2,113	2,214	2,136	2,257	2,303	2,393	2,347	2,285	2,421	2,412	2,428
California.....	23,686	21,613	24,070	23,214	23,931	23,279	24,056	24,151	23,424	24,377	23,819	24,568
Colorado.....	198	188	170	170	200	189	205	209	200	208	201	212
Illinois.....	7,401	6,695	7,308	6,914	6,862	6,680	6,756	6,706	6,582	6,857	6,713	6,776
Indiana.....	482	441	458	451	427	435	460	440	434	425	414	416
Kansas.....	9,152	8,691	9,810	9,331	9,076	8,646	8,884	8,382	8,473	8,823	8,314	8,310
Kentucky.....	476	513	526	564	640	664	737	732	74	824	719	873
Louisiana.....	9,850	9,130	10,314	10,368	10,323	9,690	10,460	10,640	10,470	10,843	10,401	10,780
Michigan.....	1,785	1,625	1,795	1,784	1,860	1,717	1,786	1,777	1,729	1,693	1,621	1,640
Mississippi.....	1,768	1,589	1,639	1,679	1,653	1,612	1,685	1,674	1,438	1,498	1,408	1,392
Montana.....	573	572	619	634	661	686	682	682	688	696	703	730
Nebraska.....	66	61	111	107	107	107	107	107	107	107	107	107
New Mexico.....	3,053	2,828	2,975	3,054	3,157	3,182	3,426	3,438	3,378	3,492	3,382	3,492
New York.....	213	209	203	203	203	203	203	203	203	203	203	203
Ohio.....	10,557	9,813	10,546	10,203	10,222	10,169	10,341	10,287	10,022	10,340	10,102	10,238
Oklahoma.....	3,368	3,220	3,419	3,348	3,367	3,319	3,319	3,330	3,290	3,246	3,228	3,215
Pennsylvania.....	40,943	38,020	43,502	43,401	47,160	46,632	50,389	53,649	55,314	59,360	58,397	58,683
Texas.....	2,065	2,061	2,061	2,061	2,061	2,061	2,061	2,061	2,061	2,061	2,061	2,061
West Virginia.....	2,764	2,478	2,641	2,706	2,869	2,803	2,885	3,017	2,963	3,005	2,962	2,740
Wyoming.....	4	4	4	4	4	4	4	4	4	4	4	4
Total United States: 1943.....	117,372	108,487	121,648	119,100	123,957	120,111	127,629	130,796	130,564	136,837	133,824	135,288
Daily average, 1943.....	3,786	3,875	3,924	3,970	3,999	4,004	4,117	4,219	4,352	4,414	4,461	4,364

1. Final figures.
2. Includes Florida, Kentucky, Tennessee, and Virginia.
3. American Petroleum Institute.
4. Florida (4), Missouri (36), Tennessee (10), and Virginia (2).

Production of crude petroleum in the United States in 1944, by districts, States, and months

[Thousands of barrels]

District and State	1944 ¹												Total
	January	February	March	April	May	June	July	August	September	October	November	December	
DISTRICT													
Pennsylvania Grade	1,984	1,909	2,071	1,930	2,131	1,990	1,681	2,297	1,923	1,947	1,881	1,703	23,397
Other Appalachian ²	1,803	1,762	836	1,749	2,863	861	1,866	1,005	1,974	1,067	1,079	1,010	10,875
Lima-Northeastern Indiana-Michigan	1,635	1,589	1,610	1,550	1,626	1,533	1,477	1,606	1,484	1,544	1,531	1,524	18,709
Illinois-Southwestern Indiana	7,198	6,811	7,152	6,775	7,037	6,669	6,779	6,971	6,685	6,961	6,701	6,768	82,507
Mid-Continent:													
North Louisiana, Arkansas, Alabama, and Mississippi	5,847	5,537	5,812	5,709	5,723	5,705	5,842	6,030	5,848	6,030	5,826	5,903	69,812
West Texas and Southeastern New Mexico	15,013	14,040	14,458	15,039	16,909	16,709	17,571	18,363	18,275	18,545	17,391	17,773	200,086
East Texas	11,527	11,447	11,358	10,801	11,335	10,578	11,210	11,666	11,167	11,641	11,118	11,573	135,421
Oklahoma, Kansas, North Texas, etc.	33,276	31,652	34,265	32,996	35,159	34,082	34,738	35,778	35,198	36,084	35,529	35,646	414,403
Gulf Coast	29,562	27,790	29,895	29,420	31,080	30,138	31,061	31,331	30,801	31,748	31,366	32,125	366,317
Rocky Mountain	3,725	3,488	3,628	3,636	3,547	3,548	3,649	3,625	4,002	4,080	3,690	3,815	44,433
California ³	25,197	23,876	25,667	24,988	25,883	25,438	26,413	26,624	26,632	27,291	26,342	27,442	311,793
Total United States	135,767	128,901	136,752	133,593	141,293	137,251	141,287	145,296	142,989	146,938	142,404	145,282	1,677,753
STATE													
Arkansas	2,450	2,307	2,490	2,431	2,475	2,426	2,460	2,564	2,428	2,493	2,416	2,478	29,418
California ³	25,197	23,876	25,667	24,988	25,883	25,438	26,413	26,624	26,632	27,291	26,342	27,442	311,793
Colorado	6,783	6,391	6,704	6,340	6,614	6,293	6,375	6,539	6,267	6,519	6,246	6,349	77,413
Illinois	417	422	450	437	425	408	406	434	426	444	428	421	5,118
Indiana	8,360	7,964	8,497	7,826	8,006	8,310	8,177	8,425	8,104	8,213	8,203	8,087	98,762
Kansas	695	663	720	647	748	759	783	886	870	969	969	912	9,621
Louisiana	10,681	10,306	10,951	10,695	11,026	10,626	10,728	10,993	10,630	11,101	10,529	10,841	129,207
Michigan	1,621	1,576	1,597	1,542	1,601	1,508	1,459	1,583	1,464	1,520	1,510	1,509	18,490
Mississippi	1,343	1,268	1,297	1,250	1,244	1,295	1,354	1,401	1,384	1,476	1,508	1,547	16,337
Montana	744	700	741	704	738	710	675	769	715	733	693	705	8,627
Nebraska	37	26	39	37	35	34	38	40	35	34	32	30	417
New Mexico	3,490	3,310	3,557	3,396	3,366	3,165	3,262	3,288	3,148	3,241	3,139	3,213	39,555
New York	387	381	399	375	375	419	362	380	392	393	376	361	4,697
Ohio	253	232	263	229	276	247	190	295	240	257	237	218	2,937
Oklahoma	10,111	9,611	10,533	9,987	10,477	9,984	10,150	10,470	10,504	10,913	10,860	11,016	124,616
Pennsylvania	1,202	1,149	1,183	1,183	1,292	1,206	1,032	1,367	1,160	1,151	1,098	1,014	14,118
Texas	58,782	55,711	58,487	58,375	63,013	61,403	64,288	66,039	65,091	66,608	64,485	65,840	748,122
West Virginia	259	254	270	249	280	258	233	293	252	294	248	219	3,070
Wyoming	2,722	2,559	2,626	2,678	2,514	2,598	2,679	2,552	2,875	3,018	2,700	2,707	32,388
Other States	6	6	5	7	7	9	7	11	11	12	10	12	103
Total United States: 1944	135,767	128,901	136,752	133,593	141,293	137,251	141,287	145,296	142,989	146,938	142,404	145,282	1,677,753
Daily average, 1944	117,372	108,487	121,648	119,100	123,957	120,111	127,629	130,796	130,564	136,837	133,524	135,288	1,504,613
Daily average, 1944	4,380	4,445	4,411	4,453	4,558	4,687	4,558	4,687	4,766	4,740	4,747	4,687	54,594

¹ Subject to revision. ² Includes Florida, Kentucky, Tennessee, and Virginia. ³ American Petroleum Institute. ⁴ Alabama (43), Florida (12), Missouri (36), Tennessee (9), and Virginia (3).

Percentage of total crude petroleum produced in the United States, 1935-44, by principal States

State	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944 ¹
Texas	39.4	38.9	39.9	39.2	38.2	36.4	36.1	34.8	29.5	44.6
California	20.9	19.5	18.6	20.6	17.7	16.6	16.4	17.9	18.9	18.6
Louisiana	5.0	7.3	7.1	7.8	7.4	7.7	8.3	8.3	8.2	7.7
Oklahoma	18.6	18.8	17.9	14.4	12.7	11.5	11.0	10.2	8.2	7.4
Kansas	5.8	5.3	5.5	5.0	4.8	4.9	5.9	7.0	7.0	5.9
Illinois	4.4	4.4	4.6	2.0	7.5	10.9	9.4	7.7	5.5	4.6
New Mexico	2.1	2.5	3.1	2.9	3.0	2.9	2.8	2.3	2.6	2.4
Wyoming	1.4	1.3	1.5	1.6	1.7	1.9	2.1	2.4	2.3	1.9
Arkansas	1.1	.9	.9	1.5	1.7	1.9	1.9	1.9	1.8	1.8
Michigan	1.5	1.1	1.3	1.5	1.8	1.5	1.2	1.6	1.4	1.1
Mississippi						.3	1.1	2.1	1.2	1.0
Pennsylvania	1.6	1.6	1.5	1.4	1.4	1.3	1.2	1.3	1.0	.8
All other	2.5	2.4	2.1	2.1	2.1	2.2	2.6	2.5	2.4	2.2
Total United States	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

¹ Subject to revision.

Production of crude petroleum in leading fields and districts in the United States, 1943-44, and total production since discovery¹

[Thousands of barrels]

Field	State	1943	1944	Total since discovery
East Texas	Texas	129,112	134,674	2,114,621
Wilmington	California	34,381	36,943	245,270
Coalinga	do.	31,388	35,404	472,758
Wasson	Texas	12,684	24,500	78,850
Conroe	do.	19,995	24,200	186,272
Slaughter-Dean	do.	11,205	23,981	49,958
Hastings	do.	17,916	21,800	85,420
Webster	do.	11,473	20,600	44,692
Ventura Avenue	California	16,470	17,507	285,453
Huntington Beach	do.	13,259	17,165	344,033
Bradford-Allegany ²	Pennsylvania-New York	18,358	16,535	511,440
Oklahoma City	Oklahoma	20,338	16,295	610,031
Gray County	Texas	15,770	16,164	230,289
Midway-Sunset	California	14,954	15,179	675,976
Kettleman North Dome	do.	16,299	15,128	295,697
Seminole	Oklahoma	16,599	13,917	948,142
Thompson	Texas	10,115	13,475	62,403
Hawkins	do.	14,773	13,449	34,921
Yates	do.	9,548	13,005	297,894
Hutchinson County	do.	11,680	12,034	190,428
Tinsley ³	Mississippi	17,290	11,821	76,645
Anahac	Texas	8,539	11,700	44,185
Van	do.	6,120	11,651	150,992
Santa Maria Valley	California	8,305	11,281	49,419
Louden	Illinois	13,702	11,175	112,511
Long Beach	California	11,625	10,858	702,612
McElroy	Texas	6,151	10,400	143,458
North Cowden	do.	3,939	9,280	37,211
Salem	Illinois	10,220	8,310	185,551
West Ranch	Texas	6,782	8,100	26,145
West Edmond	Oklahoma	5,322	7,752	8,974
Elk Hills	California	5,374	7,719	175,251
Monument	New Mexico	7,190	7,570	66,545
Seeligson	Texas	1,559	7,260	9,536
Santa Fe Springs	California	7,309	6,838	496,562
Lance Creek	Wyoming	7,439	6,060	63,170
Funio	New Mexico	6,498	6,470	71,750
Behridge	California	4,549	6,350	90,009
Cut Bank	Montana	5,339	5,475	42,373
Old Ocean	Texas	4,819	5,450	23,305
Stowell	do.	1,783	5,380	7,429
Rodessa	Arkansas-Louisiana-Texas	5,524	4,840	144,446
Salt Creek	Wyoming	4,805	4,810	312,870
Hobbs	New Mexico	3,780	4,120	108,299

¹ Oil and Gas Journal.

² Bureau of Mines.

³ Revised figure.

Alabama.—The discovery of the Gilbertown field, Choctaw County, marked the first commercial oil production in Alabama. The discovery well was drilled to 5,380 feet in the Comanche formation and plugged back to 2,585 feet, where it flowed 30 barrels of oil per day from fractured Selma chalk. A second well 5 miles west of the discovery found 50 barrels of oil and 40 barrels of salt water in upper Eutaw sands below 2,800 feet. Subsequent development of production between these two wells indicates probable continuity of a single field. Nine producers and five dry holes were drilled in 1944, and total oil produced was 56,000 barrels.

Nineteen wildcat wells were drilled in Alabama in 1944, principally in southwestern counties.

Arkansas.—Production of crude petroleum increased from 27,600,000 barrels in 1943 to 29,418,000 in 1944—a 7-percent gain in contrast to a 4-percent expansion in 1943 over 1942. Substantially higher production in the Atlanta, Dorcheat-Macedonia, McKamie,

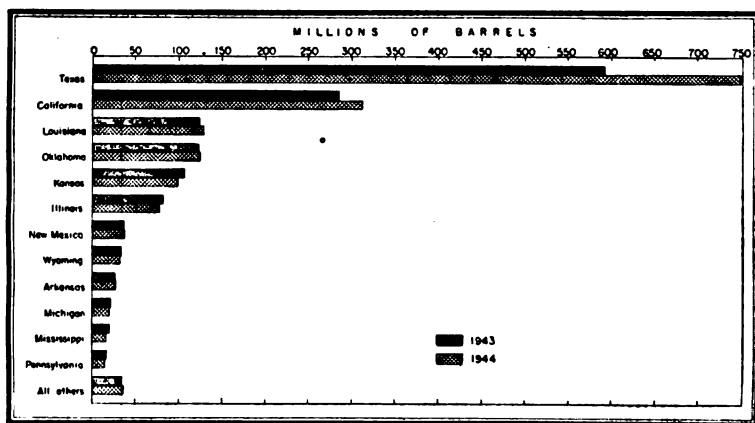


FIGURE 3.—Production of crude petroleum in the United States, 1943-44, by States.

Midway, and Stephens fields offset losses in several areas, resulting in a net gain for the State.

Three minor fields—Calhoun, Wilkes, and Salem Church—were discovered in 1944. The Calhoun field is in Columbia County, and the other two are in Union County. The new production came from the Smackover lime, and the six wells in these new areas produced up to 100 barrels of oil or distillate a day each, at varying depths down to 8,300 feet. All drilling sites in the new fields were located by the seismograph.

There were 215 wells drilled for oil or gas in Arkansas in 1944 compared with 243 in 1943; however, results were more satisfactory in 1944, as the relative proportion of dry holes declined.

California.—Production of petroleum increased 10 percent in 1944 to 311,793,000 barrels, exceeding the old record in 1929 by 19,259,000 barrels. The trend was strongly upward through the first 9 months of 1944, and after hesitation in the fourth quarter gains continued in early 1945 as demand increased with the scope of military operations in the Pacific theatre of war.

Production of crude petroleum in Arkansas, 1940-44, by fields

[Thousands of barrels]

Year	At-lanta	Buck-ner	Dor-cheat-Mace-donia	El Do-rado	Mc-Kamle	Mag-nolia	Mid-way	Schu-ler	Smack-over	Ste-phens	Ur-bana	Other fields	Total
1940	721	815	409	591	74	7,383	-----	6,547	5,500	196	468	13,071	25,775
1941	1,013	816	797	534	891	7,121	-----	6,055	5,351	251	837	12,661	26,327
1942	1,034	765	1,012	497	723	6,364	1,218	5,913	4,907	614	985	12,596	26,628
1943	956	660	1,602	449	360	6,041	2,168	5,520	4,458	1,485	1,058	12,843	27,600
1944 ¹ ..	1,164	666	2,345	416	1,107	5,592	2,382	5,105	4,280	1,828	1,019	13,514	29,418

¹ Includes oil consumed on leases and net change in stocks held on leases for entire State.² Subject to revision.³ Includes New London.

The output of San Joaquin Valley fields increased 11 percent to 147,494,000 barrels, equaling 47 percent of total production in 1944, as in 1943. Increased output was reported in a number of fields, led by Coalinga, which gained over 4 million barrels, and Elk Hills, which responded to an intensive campaign of development. By Public Law 344, passed by Congress June 17, 1944, the Secretary of the Navy was authorized to develop Naval Petroleum Reserve No. 1 at Elk Hills to produce 65,000 barrels per day. By the end of September, 19 strings of tools were operating, and wells were completed rapidly through the end of the year. By February 24, 1945, 169 wells had been drilled, and daily production of the field had risen from about 15,000 barrels to over 63,000 barrels. The objective of 65,000 barrels daily was reached in March 1945, somewhat sooner than was initially estimated. The only field in the valley to show a large decline was Ten Section, which produced 4,624 thousand barrels in 1944, or 1,934 thousand barrels less than in 1943.

Production in the Coastal district increased 23 percent over 1943 to 50,003 thousand barrels. The largest gains were in the Santa Maria Valley and Ventura Avenue fields, which together produced over half the district's additional oil.

The Los Angeles Basin output increased from 110,628 to 114,296 thousand barrels owing to 3,923 thousand barrels more production from Huntington Beach and 2,580 thousand barrels more from the Wilmington field than in 1943. Other fields in the district, many of which are in the decline stage, produced 2,835 thousand barrels less in 1944 than in 1943.

Drilling was at record levels, 41 percent above 1943, spurred by the prospect of growing demand for petroleum for an indefinite period. Completions totaled 2,043, of which 1,663 were oil wells. The drilling of 316 exploratory holes resulted in 62 successful oil wells. The fields of most active development and the number of oil wells completed in 1944 in each were as follows: South Belridge 199, Wilmington 144, Midway-Sunset 138, Elk Hills 103, and East Coalinga 94. The world's deepest well was drilled into lower Miocene formations in the Cole's Levee field to a depth of 16,246 feet in 1944 and abandoned as a dry hole early in 1945.

The discovery of 25 new oil-producing areas and 8 new pools in oil fields was reported in 1944, in addition to numerous extensions to old fields. About half of the discoveries were in Kern County. None of the new fields was reported to be of major importance.

Probably the largest proved additions to reserves were uncovered in new pays in the Buena Vista Hills field, Kern County, and San Miguelito, Ventura County. The opening of production from 2 sands in the Pliocene at Northwest Elk Hills, Kern County, may develop important reserves.

Production of crude petroleum in California, 1940-44, by districts and fields

[Thousands of barrels]

District and field	1940	1941	1942	1943	1944 *
San Joaquín Valley:					
Beiridge.....	4,614	4,185	2,917	4,543	6,340
Canal.....	2,034	1,816	1,069	1,446	1,297
Coalinga.....	9,916	14,224	19,323	31,386	35,410
Coles Levee ¹	2,589	5,717	5,436	5,906	6,692
Edison.....	868	1,013	1,020	900	1,051
Elk Hills.....	4,427	3,491	4,363	5,373	7,719
Fruitvale.....	2,072	2,085	2,312	2,571	3,043
Greeley.....	1,475	2,480	2,583	4,819	5,219
Kern River—Kern Front.....	4,082	4,315	5,707	7,274	8,440
Kettleman Hills.....	16,730	13,983	13,014	15,300	15,133
Lost Hills.....	1,405	1,263	1,398	1,328	1,284
McKittrick.....	1,317	1,422	1,791	1,719	1,851
Midway-Sunset ⁴	18,397	17,461	20,470	20,227	22,065
Mountain View.....	2,415	1,910	1,602	1,394	1,156
Mount Poso.....	3,425	4,117	7,566	8,432	8,025
Rio Bravo.....	3,304	4,534	3,579	5,446	5,920
Round Mountain.....	2,691	2,815	3,917	4,150	3,932
Ten Section.....	3,518	5,232	4,805	6,558	4,624
Other San Joaquín Valley.....	2,003	1,748	2,203	4,267	8,293
Total San Joaquín Valley.....	87,282	93,811	105,075	133,039	147,494
Coastal district:					
Capitan.....	651	740	844	1,178	1,079
Elwood.....	1,286	1,166	873	1,668	2,133
Gato Ridge.....			1,217	1,295	1,777
Rincon.....	1,609	1,542	1,010	1,210	1,501
San Miguelito.....	1,163	1,427	1,238	1,614	2,111
Santa Maria.....	2,216	3,183	2,726	3,791	4,892
Santa Maria Valley.....	6,096	6,908	7,550	8,303	11,358
Ventura Avenue.....	12,570	12,892	13,644	15,461	17,504
Ventura-Newhall.....	2,866	4,279	3,041	3,639	4,133
Other Coastal.....	101	87	1,805	2,362	3,515
Total Coastal.....	28,558	32,224	33,948	40,521	50,003
Los Angeles Basin:					
Brea Olinda.....	2,070	2,079	3,716	4,252	4,304
Coyote.....	4,053	4,466	5,848	6,502	6,434
Dominguez.....	7,665	8,495	7,932	9,118	7,879
Huntington Beach.....	9,592	10,743	12,096	13,239	17,162
Inglewood.....	4,366	4,901	6,750	6,913	6,467
Long Beach.....	16,010	14,697	13,131	11,641	10,862
Montebello.....	7,240	4,884	3,961	3,966	3,932
Playa del Rey.....	1,498	1,319	1,227	972	950
Richfield.....	3,228	2,719	2,890	2,689	2,564
Rosecrans.....	4,259	3,434	2,722	2,215	2,238
Santa Fe Springs.....	9,438	8,552	7,761	7,307	6,838
Seal Beach.....	2,557	2,430	3,027	2,867	2,835
Torrance.....	4,007	3,210	3,049	2,874	3,186
Wilmington.....	30,195	30,672	33,657	34,349	36,929
Other Los Angeles Basin.....	1,863	1,627	1,536	1,724	1,716
Total Los Angeles Basin.....	108,041	104,228	109,303	110,628	114,296
Total California.....	223,881	230,263	248,326	284,188	311,793

¹ American Petroleum Institute.

² Subject to revision.

³ Includes Tupman.

⁴ Includes Buena Vista Hills.

Colorado.—A sharp gain in output of the Wilson Creek field lifted Colorado production 27 percent to 2,944,000 barrels in 1944, a new record slightly above the old high of 1927. Production at Wilson Creek increased 84 percent over 1943 to 1,401,000 barrels, and Rangely gained 33 percent to 379,000 barrels.

Oil-well completions numbered 22 compared with 11 in 1943. Completions, by active fields, were: Clark's Lake 5 oil wells, North McCallum 5, Wilson Creek 5, and Rangely 3.

Development at Rangely in 1944 established a major reserve from which a 10-inch pipe line is projected for construction in 1945. A deep test at Powder Wash, Moffat County, was completed late in 1944, proving production from five sands—two oil, two gas, and one gas-condensate—between 4,000 and 5,200 feet.

Production of crude petroleum in Colorado, 1940-44, by fields

[Thousands of barrels]

Year	Flor- ence- Canon City	Fort Collins- Well- ington	Hu- tha	Iles	Mof- fat	Price	Pow- der Wash	Rangely	Tow Creek	Wilson Creek	Other fields	Total
1940.....	56	128	75	581	111	326	-----	29	52	237	131	1,626
1941.....	55	118	191	547	116	324	42	220	50	453	134	2,150
1942.....	49	111	185	534	125	272	37	288	46	533	119	2,199
1943.....	44	102	164	480	118	253	44	285	46	760	124	2,320
1944 ^a	44	96	100	454	112	247	50	379	44	1,401	117	2,944

¹ Includes crude oil consumed on leases and net change in stocks held on leases for entire State.

^a Subject to revision.

Florida.—The State's only producing well, in the Sunniland field, Collier County, produced 11,832 barrels of 19° A. P. I. gravity oil in 1944 compared with 4,037 in 1943. Six wells were drilled in 1944; however, all were abandoned. Depths of these dry holes ranged from 3,540 feet to 13,512 feet, and exploration was limited to Collier, Gulf, Leon, and Madison Counties. The formation tested was undetermined in Madison County; however, it was believed that the Comanche was penetrated in the other counties. Four wildcats were drilling at the end of 1944, and broader activities were expected in 1945.

Illinois.—Production of 75,822,000 barrels of oil in 1944 represented a 6-percent decline from 1943 and a 48-percent drop from the peak of 1940. Declines were reported from most fields, led by Loudon and Salem, the largest producers. The largest gain (2.1 million barrels) was reported from the Clay City field, where secondary recovery operations (water flood) are progressing. The relatively new Mount Erie field, Wayne County, increased its output from 229,000 barrels in 1943 to 1,322,000 barrels in 1944.

Oil-well completions were 1,196 compared with 1,046 in 1943. New oil wells in the most active fields were: Clay City 179, Albion 62, Phillipstown 60, Bible Grove 56, and Mount Carmel 44. Of 279 wells classified as wildcats, 22 discovered new oil pools. Exploration was directed chiefly toward the deeper parts of the Interior Coal Basin, and most of the discoveries were recorded there. The most important new pools indicated were: Boyd, Roaches North, and Divide West, in Jefferson County; and Calhoun, in Richland County. Except for the Lancaster East pool, Wabash County, which produced from the Pennsylvanian, all of the new pools obtain their oil from the Chester of Upper Mississippian and St. Genevieve beds of Lower Mississippian age.

The seismograph and subsurface geology are the two methods most used in Illinois exploration. However, the use of the seismograph declined about 50 percent in 1944. A few holes were drilled below the Mississippian but none was productive.

Production of crude petroleum in Illinois, 1940-44, by fields ¹

[Thousands of barrels]

Field	1940	1941	1942	1943	1944
Benton.....		5,792	5,488	2,534	1,655
Bible Grove.....			286	763	985
Boyleston.....	1,306	815	669	425	1,020
Bridgeport.....	1,641	2,092	2,027	1,880	1,932
Centralla.....	10,642	3,564	2,277	1,683	1,785
Clay City.....	6,922	4,680	3,633	2,764	4,890
Dale-Hoodville.....	667	6,195	5,294	3,909	3,160
Dundas.....	2,341	4,438	2,605	1,295	780
Inman.....	4	462	693	795	1,005
Iola.....			18	1,003	1,085
Johnsonville.....		5,913	5,146	2,170	1,460
Keensburg.....	2,709	2,002	1,710	1,138	873
Louden.....	26,596	22,918	17,961	13,702	11,175
Mount Carmel.....	26	1,691	1,024	854	1,330
Mount Erie.....		41	87	229	1,332
New Harmony.....	1,503	9,963	7,224	5,257	4,395
Noble and Schnell.....	2,766	2,521	2,699	2,601	2,165
Patoka.....	419	1,076	969	774	940
Phillipstown.....	49	56	182	1,112	985
Roland.....	2	1,101	1,889	1,120	760
Rural Hill.....		1,570	3,738	1,715	925
Salem.....	70,734	29,539	14,705	10,220	8,310
Sims.....		12	1,706	1,488	965
St. James.....	1,713	1,871	1,477	1,130	930
Woodlawn.....		2,465	2,997	1,446	960
Other fields.....	16,411	17,854	19,978	18,722	20,020
	148,451	128,631	106,282	80,729	75,822

¹ Oil and Gas Journal.

Indiana.—Production declined only slightly in 1944 to 5,118,000 barrels from 5,283,000 barrels in 1943. The Griffen pool produced 2,004,000 barrels in 1944 and 2,393,000 in 1943. The next largest producing fields in 1944 were New Harmony (396,000 barrels) and Mount Vernon (379,000 barrels). Owensville (and North) gained sharply to 248,000 barrels in 1944 because of new development. Two new fields which had very little output in 1943, Inman and Upton (Posey County), produced 151,000 and 107,000 barrels, respectively, in 1944.

Oil-well completions increased from 96 in 1943 to 144 in 1944. The most activity, with number of oil wells completed, was: North Owensville 23, Inman 22, Griffen 16, New Harmony South 14, and Upton 12.

Three new fields were discovered in 1944—the New Harmony South and Hovey in Posey County and Cato in Pike County. The St. Thomas pool, Knox County, was extended materially to the south.

Production of crude petroleum in Indiana, 1940-44, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	Total
1940	203	235	329	314	337	366	400	505	516	583	609	581	4,978
1941	627	572	642	619	648	644	656	627	595	600	566	615	7,411
1942	620	524	604	594	627	588	579	571	529	532	485	490	6,743
1943	482	441	458	451	427	435	460	440	434	425	414	416	5,283
1944 ¹	417	422	450	437	425	408	406	434	426	444	428	421	5,118

¹ Subject to revision.

Kansas.—Following 4 years of expansion, production declined from 105,697,000 barrels in 1943 to 99,857,000 in 1944. Minor reductions in output were the rule in all principal fields, more than 10 of which attained peaks in withdrawals in 1943. The three largest producing areas—Trapp-Sellens, Silica-Raymond, and Bemis-Walters—reported the greatest declines, followed by Peace Creek, which fell 44 percent. The largest increase in production was from the Carmi field, Pratt County, a 1943 discovery which produced over 2 million barrels in 1944.

Oil-well completions numbered 824 or 56 less than in 1943, although total completions were 102 greater in 1944 owing to greater exploratory effort and drilling in proved gas territory. The number of oil wells drilled in areas of greatest development in 1944 were: Kraft-Prusa 43, Zenith-Peace Creek 33, Trapp 31, Chitwood 25, Hall-Gurney and Morel 24 each.

Wildcatting results were generally discouraging, as no major new pools were indicated. The opening of large production from the Lansing-Kansas City limestone in the Adell pool, Sheridan County, was perhaps the most important development because it extended about 15 miles northwestward the area in which porous zones may be expected in this important producing formation. Ten producing wells and no dry holes were drilled in 1944, indicating one of the large reserves in northwestern Kansas. Three Simpson pools—Coates, Ludwick, and Shriver—were discovered in Pratt County, but none of these appears to have the prolific sand conditions of the nearby Chitwood field. Production from the Viola limestone was discovered in the Skinner field, Barber County.

Three discoveries were reported in Stafford County: The St. Johns and Richland pools producing from Arbuckle dolomite and McCandless producing from Simpson sand. Several new pools and extensions were developed in Rooks and Ellis Counties near recently discovered producing areas, and other scattered discoveries, apparently of minor potentialities, were made along the Barton arch district.

Production of crude petroleum in Kansas, 1940-44, by counties and selected fields¹

[Thousands of barrels]

County and field	1940	1941	1942	1943	1944
Barton:					
Kraft-Prusa	611	1,405	2,965	3,890	3,753
Silica-Raymond	5,763	7,615	9,063	9,825	7,834
Other fields	2,733	3,682	4,286	4,561	4,186
Ellis:					
Bemis-Walters	3,419	4,866	5,847	6,720	5,268
Burnett	1,771	3,291	4,097	4,948	3,715
Other fields	342	477	446	461	490
Ellsworth:					
Stoltenberg	1,056	2,427	2,711	3,083	2,031
Other fields	547	473	450	407	1,089
McPherson:					
Bornholdt-Welch	1,029	1,783	1,857	1,830	1,591
Lindsborg		61	202	924	943
Ritz Canton	1,373	1,366	1,145	960	864
Vosbell	562	586	535	630	630
Other fields	1,347	1,500	1,754	1,827	1,552
Phillips:					
Ray	8	175	731	1,140	1,172
Other fields	7	12	133	269	286
Pratt:					
Carmi				662	2,067
Other fields	44	85	124	323	1,004
Reno:					
Burton	2,625	2,539	2,101	1,740	1,525
Peace Creek		36	1,650	2,914	1,638
Other fields	634	639	555	533	335
Rice:					
Chase-Campbell	2,338	2,746	3,379	3,750	3,702
Geneseo-Edwards	1,814	2,694	3,716	3,941	3,268
Other fields	1,653	1,457	1,255	1,194	777
Russell:					
Hall-Gurney	2,243	3,520	4,057	3,780	3,750
Trapp-Sellens	5,481	7,577	9,726	10,840	9,347
Other fields	4,709	4,826	5,758	5,813	4,840
Sedgwick:	1,156	1,093	1,011	929	823
Stafford:					
Zenith	1,838	3,176	3,593	3,765	3,624
Other fields	1,361	2,164	3,058	3,449	3,161
Other countries	18,582	20,160	20,674	20,589	24,592
	65,046	82,421	96,879	105,097	99,857

¹ Oil and Gas Journal.

Kentucky.—Field activities reached a new level in 1944, with the result that several new pools were discovered, and production increased from 7,883,000 barrels in 1943 to a record of 9,621,000 in 1944. There were 993 drilling tests completed in 1944 compared with 656 in 1943. The proportion of dry holes dropped from 38 percent in 1943 to 31 percent in 1944, while producing oil wells increased from 37 percent of 1943 completions to 38 percent in 1944. Most of the exploratory work was confined to the western coal basin of the State, where about 700 test wells were completed in 1944 (216 in 1943) to prove 12 new pools. Initial production in the new areas ranged from 13 to about 125 barrels per day at depths of 1,026 to 2,710 feet. The East Clay pool, discovered in Webster County in August and producing from a Pennsylvanian formation, made the best initial showing in 1944.

Production of crude petroleum in Kentucky, 1940-44, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1940.....	383	422	435	438	442	405	454	449	444	464	424	428	5,188
1941.....	424	387	414	407	403	385	418	386	391	397	356	394	4,762
1942.....	344	335	376	356	348	355	361	337	357	408	460	497	4,534
1943.....	476	513	526	564	640	664	737	732	774	825	759	673	7,883
1944 ¹	695	663	720	647	748	759	783	886	870	969	969	912	9,621

¹ Subject to revision.

Louisiana.—Production increased 5 percent over 1943 to a new record of 129,207,000 barrels, owing to continued gains in the Gulf district that have offset declines in the north for 2 years. Gains were reported from numerous Gulf fields, the largest being at Vinton, which also led the State in development. Other notable gains were at Bayou Sale, Delta Farms, Gibson, and Neale.

In Northern Louisiana production declined 12 percent to 24,014,000 barrels as smaller output was indicated from all leading fields. Haynesville declined almost 1.6 million barrels (29 percent) from its 1943 peak, and the output of Olla and Rodessa continued to shrink materially. A large repressuring project was initiated in 1945 to sustain production at Haynesville.

Oil-well completions in the Gulf district increased from 210 in 1943 to 310 in 1944 as development of known fields increased. Those with the largest number of new oil wells in 1944 were: Vinton 29, Neale 15, Delta Farms 15, and Pine Prairie 14. In the Northern district oil-well completions fell from 126 in 1943 to 119 in 1944, but the number of dry holes and gas wells increased. The most active fields were Holly (20 oil wells), Caddo (17), Holly Ridge (16), and Lake St. John (16).

In Southern Louisiana, 13 new fields were discovered as a result of 57 wildcat wells drilled. Most of the new fields were in a belt crossing the State 40 to 50 miles inland from the Gulf of Mexico. On the basis of early development, several of the new fields promise important reserves. The complex nature of most structures in the area, however, causes the projection of information ahead of the drill to have an inherently high factor of error.

New pay sands were found or important extensions made in many fields, including Bully Camp, Caillou Island, Pine Prairie, Batemen Lake, Bastian Bay, and Delta Farms.

In Northern Louisiana two oil fields and three condensate fields were discovered in 1944. The Delhi oil field, Richland Parish, in which oil was discovered from sand of probable Paluxy age at 3,273 to 3,291 feet, marks the first commercial oil production in north-eastern Louisiana. In DeSoto Parish, the Trenton oil field also produced from the Paluxy formation, at 2,728 to 2,732 feet. The three condensate fields were Benton in Bossier Parish, Sicily Island in Catahoula Parish, and Tremont in Lincoln Parish.

An important deep pay discovery was made in the Haynesville field, Claiborne Parish, when 44° gravity oil was produced from sands in the Cotton Valley formation below 8,800 feet.

Production of crude petroleum in Louisiana, 1940-44, by districts and fields

[Thousands of barrels]

District and field	1940	1941	1942	1943	1944 ¹
Gulf Coast:					
Anse la Butte.....	380	1,446	2,235	2,191	2,620
Barataria.....	428	989	1,081	1,129	1,135
Bayou Sale.....	.....	121	943	1,908	3,112
Black Bayou.....	1,007	838	895	1,101	1,019
Bosco.....	1,718	1,494	1,375	1,094	1,046
Caillou Island.....	2,493	2,002	1,619	1,829	1,939
Chachahoula.....	465	489	618	937	637
Chalkley.....	950	1,680	1,614	1,496	1,254
Charenton.....	2,724	1,849	1,380	1,116	1,040
Delta Farms.....	21	151	309	1,013	2,218
East White Lake.....	.....	76	217	562	1,044
Eola.....	3,985	3,668	3,313	3,137	2,158
Garden Island.....	1,106	1,225	1,256	1,357	1,256
Gibson.....	1,335	1,407	1,324	2,543	3,542
Golden Meadows.....	4,074	4,814	4,424	3,606	2,796
Grand Bay.....	1,168	2,022	2,010	2,522	2,724
Grand Lake.....	1,417	1,625	1,153	951	841
Gueydan.....	359	694	1,048	1,504	1,963
Hackberry.....	3,312	3,768	3,316	3,725	4,057
Iowa.....	3,475	3,400	2,506	2,928	3,309
Jennings.....	5,505	4,991	4,402	3,416	2,840
Lafitte.....	4,602	4,523	3,750	4,688	4,452
Lake Salvador.....	41	611	718	988	1,554
Leeville.....	1,135	1,597	981	1,214	1,421
Neale.....	819	834	884	1,333	2,342
New Iberia.....	3,076	2,760	2,287	2,606	2,615
North Crowley.....	1,602	2,004	1,803	1,699	1,624
Paradis.....	350	1,085	2,246	4,173	4,013
Pine Prairie.....	.....	240	842	1,402	1,944
Port Barre.....	810	1,025	965	1,215	1,176
Quarantine Bay.....	1,585	2,311	2,107	2,567	2,877
Roanoke.....	965	851	612	600	764
St. Gabriel.....	.....	554	1,345	1,732	1,957
Sulphur.....	970	921	700	801	741
Tepetate.....	1,656	1,481	1,000	912	878
University.....	3,496	3,591	3,289	2,896	2,338
Venice.....	855	1,163	1,294	2,147	2,920
Ville Platte.....	4,493	6,119	6,446	4,450	3,642
Vinton.....	300	323	369	661	1,942
West Bay.....	4	408	743	878	1,055
West Lake Verrett.....	172	646	872	837	1,015
White Castle.....	806	922	907	1,271	1,437
Other Gulf Coast.....	116,069	119,199	115,477	117,059	118,636
Total Gulf Coast.....	79,178	90,917	86,475	96,194	105,193
Northern:					
Caddo.....	2,912	3,077	2,694	2,421	2,129
Cotton Valley.....	5,189	3,459	2,033	1,532	724
Haynesville.....	987	956	4,621	5,368	3,816
Homer.....	1,041	1,033	1,060	1,067	1,019
Lisbon.....	1,482	896	758	585	403
Nebo ²	54	974	3,424	3,668	3,466
Olla ³	942	4,641	6,107	4,852	4,221
Rodessa.....	6,859	5,212	4,100	3,462	2,930
Shreveport.....	1,555	1,011	923	777	690
Urania.....	869	832	778	739	678
Other Northern.....	2,516	2,900	2,812	2,927	3,938
Total Northern.....	24,406	24,991	29,310	27,398	24,014
Total Louisiana.....	103,584	115,908	115,785	123,592	129,207

¹ Subject to revision.² Includes crude oil consumed on leases and net change in stocks held on leases for entire district.³ Includes Hemphill, Trout Creek, and Jena.⁴ Includes Little Creek and Summerville.

Michigan.—Crude-oil production declined for a second consecutive year when the 1944 total of 18,490,000 barrels was 11 percent below the 1943 output of 20,768,000 barrels. Gains in the Adams (Arenac County), Ford (Mecosta County), and Kawkawlin (Bay County) fields were not sufficient to offset losses in the important Reed City (Osceola and Lake Counties) and six lesser areas. Production in the

Reed City field declined from a peak of 9,102,000 barrels in 1942 (42 percent of the State total) to 7,847,000 in 1943 (38 percent of the State total) and to 5,194,000 in 1944 (28 percent of the State total).

There were 655 wells completed in 1944 compared with 628 in 1943. Oil-well completions increased from 235 in 1943 to 239 in 1944, and dry holes abandoned were 357 in 1944 compared with 346 in 1943.

Development activities resulted in the discovery of nine new oil fields and in the extension of, or new pay zones for, several others. Six of the new fields—Coldwater (Isabella County), Belly Achers (Montcalm County), Bloomer (Montcalm County), Deep River (Arenac County), Pinconning (Bay County), and Essexville (Bay County)—are in the "Basin" of Central Michigan, and production is from the Dundee or Devonian formation. Coldwater, Deep River, and Essexville added appreciably to known reserves of the State. Production depths ranged from 2,660 to 3,698 feet. Three other new fields were located in the southwestern Michigan Traverse area—Hilliards, South Monterey, and Wayland—all in Allegan County. Producing depths for Allegan County varied from 1,578 to 1,801 feet, and the highest initial daily production was for the Hilliards field—300 barrels.

Test-core drilling declined from 376 permits in 1943 to 181 in 1944, although this method of locating favorable structural conditions remained the most popular. Some gravimeter and seismographic studies also were made, and the latter technique led to the discovery of the Pinconning field in Bay County, where the initial well—Koth No. 1—produced 115 barrels an hour from the Dundee formation at 2,950 feet.

Thirty-three wildcat wells were reported in 1944, and all penetrated to the Devonian formation or deeper. Four wells in southeastern Michigan reached pre-Cambrian granite, and another sunk on the eastern edge of the "Basin" ended in Cambrian sandstone.

Production of crude petroleum in Michigan, 1940-44, by fields¹

[Thousands of barrels]

Year	Adams	Buck-eye	Fork	Head-quarters	Kaw-kaw-lin	Porter	Red-ding	Reed City	Walk-er	Win-ter field	Other fields	Total
1940.....	313	1,004	-----	-----	16	1,234	3,966	2	4,218	8	8,972	19,753
1941.....	1,118	665	-----	315	185	1,136	1,749	2,754	1,292	1,101	6,044	16,369
1942.....	1,030	496	53	2,321	492	891	740	9,102	681	1,269	4,689	21,754
1943.....	984	442	805	1,999	689	742	423	7,847	453	683	5,701	20,768
1944.....	1,177	408	1,436	1,212	724	626	312	5,194	351	377	6,673	18,490

¹ Data from Department of Conservation, Michigan.

Mississippi.—Production of crude petroleum has declined from a peak of 28,833,000 barrels in 1942 to 18,807,000 in 1943 and to 16,337,000 in 1944. Oil wells completed increased from 31 in 1943 to 78 in 1944, but reported dry holes declined from 84 in 1943 to 77 in 1944. One gas well was announced in 1944.

Although drilling activities increased greatly in 1944, the new production brought in did not offset the continued decline in the output of the important Tinsley field (Yazoo County), where 92 percent of the State's output originated in 1943 in contrast to only a 72-percent share in 1944. Expanding production in 1944 in the

Pickens field (Madison and Yazoo Counties), Heidelberg (Jasper County), Cranfield (Adams County), and Eucutta (Wayne County) helped to counteract the declining output of the Tinsley field. The latter two fields were discovered late in 1943, and each reached a production of approximately 500,000 barrels in 1944.

Four new oil fields were located in Mississippi in 1944. The most important, the Heidelberg, was discovered in January and produced about 1,400,000 barrels from 57 wells. The producing-sand zones of the field are known locally as Morrison, City Bank, Stanley, and Christmas. The Gwinville (Jefferson Davis County) and Mallalieu (Lincoln County) fields were announced in August, and the Baxterville (Lamar County) field followed in November. Bruinsburg (Claiborne County), a gas field, was also discovered in November; however, it is not believed to represent an important reserve.

The further exploration and new discoveries in Mississippi resulted in an increase in the total reserves credited to the State from 39 million barrels on January 1, 1944, to 209 million as of January 1, 1945, as indicated in the report of the Committee on Petroleum Reserves of the American Petroleum Institute.

Production of crude petroleum in Mississippi, 1940-44, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1940.....	117	189	235	231	252	317	276	578	761	480	448	516	4,400
1941.....	551	603	570	770	901	858	1,425	1,598	1,694	1,932	2,240	2,185	15,327
1942.....	2,489	2,601	2,708	2,885	2,648	2,531	2,469	2,366	2,194	2,126	1,953	1,863	28,833
1943.....	1,766	1,589	1,639	1,679	1,655	1,612	1,585	1,574	1,470	1,438	1,408	1,392	18,807
1944 ¹	1,343	1,268	1,267	1,250	1,244	1,295	1,354	1,401	1,384	1,476	1,508	1,547	16,337

¹ Subject to revision.

Montana.—Output in Montana increased 9 percent over 1943 to a new record of 8,627,000 barrels. Withdrawals from Cut Bank and Kevin-Sunburst were moderately higher, but the major gain was at Elk Basin, which produced 682,000 barrels in 1944 compared with 243,000 barrels in 1943.

Drilling, both development and wildcat, increased markedly in 1944 as a number of major oil companies became active in the region, indicating aggressive expansion of production and refining operations. A total of 221 oil-well completions was reported, 73 more than in 1943. Wildcatting in particular was active in the second half of the year. Oil-well completions in important fields were: Cut Bank 101, Kevin-Sunburst 87, High Gravity 11, Elk Basin 10, and Gage 4.

Four oil discoveries were reported, of which the Clark's Fork and Dry Creek fields, Carbon County, appeared to have the most promise. They produced from the second Frontier sand and Morrison, respectively. Oil from the Sunburst sand was found in the Willshaw block, Toole County, and at Farmington, Teton County, from the Ellis-Madison.

With respect to reserves and productive capacity, the continued development of the north end of the Elk Basin field doubtless was most important.

Production of crude petroleum in Montana, 1940-44, by fields

[Thousands of barrels]

Year	Cat Creek	Cut Bank	Dry Creek	Elk Basin	Frannie	Kevin-Sunburst	Lake Basin	Pondera	Other fields	Total
1940.....	187	4,091	175	16	5	1,923	18	305	8	6,728
1941.....	173	5,020	170	17	26	1,753	17	286	164	7,526
1942.....	138	5,509	110	16	21	1,992	13	264	111	8,074
1943.....	120	5,328	97	243	14	1,840	16	211	147	7,916
1944 ¹	116	5,414	92	682	15	1,923	13	241	131	8,627

¹ Includes crude oil consumed on leases and net change in stocks held on leases for entire State.² Subject to revision.

Nebraska.—Production declined from 635,000 barrels in 1943 to 417,000 barrels in 1944, of which the Falls City pool produced about 285,000 and Barada and Dawson about 60,000 barrels each, from a total of 79 wells.

Sixteen wildcats were drilled in 1944 without finding commercial production. Six of these were in western counties—Hitchcock, Dundy, Red Willow, and Garden. Ten were drilled in five eastern counties.

Production of crude petroleum in Nebraska, 1940-44, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1940.....	3	2	-----	-----	3	8	7	7	8	65	90	83	276
1941.....	123	101	113	132	131	134	160	193	216	221	205	169	1,896
1942.....	115	117	122	118	116	113	104	99	90	87	78	78	1,237
1943.....	66	61	71	62	62	56	52	52	49	37	36	31	635
1944 ¹	37	26	39	37	35	34	38	40	35	34	32	30	417

¹ Subject to revision.

New Mexico.—A 2-percent gain in 1944 raised production to a new record of 39,751,000 barrels. Among leading fields the greatest increases in production were reported by Monument, Hobbs, Maljamar, and Arrowhead. Loco Hills continued the decline that began in 1942. Production from fields in the northwestern part of the State gained 23,000 barrels over 1943 to 448,000 barrels.

Oil-well completions increased 101 over 1943 to 283, of which 14 were in northwestern fields. The Grayburg-Jackson area continued to be the most active, with 58 oil wells completed, followed by Square Lake with 47 and Maljamar with 28. Other active fields with oil wells completed were: Lovington South 14, Loco Hills 14, Rhodes 13, Red Lakes 12 and Arrowhead 12. In the Northwest district, Hospah had 8 oil completions, Rattlesnake 4, and Red Mountain 2.

Active exploration, particularly of deeper formations, resulted in the discovery of nine new fields, of which four appeared to be of major size. For the first time commercial production was obtained from horizons below the San Andres formation. The first discovery in these older rocks was in the Drinkard pool, Lea County, where a large well was completed in the Yeso (Clear Fork) formation below 6,375 feet in September. In November Ellenburger limestone production was obtained in the Dulbin area, Lea County, by a well which flowed 297

barrels of 50° gravity oil from a depth of 11,895 to 11,933 feet. The third Lea County deep discovery, the Skaggs field, was made when production was obtained in December from the Wolfcamp formation at 7,700 to 7,725 feet. The well drilled to pre-Cambrian rocks at 10,440 feet, having missed the Ellenburger limestone.

Discovery of the West Lovington field (Lea County), producing from 375 feet of broken pay in the San Andres formation resulted in the largest addition to proved reserves in 1944. Fourteen wells were completed before the end of the year.

The Vacuum field was extended 2 miles westward by a small well, completed in September.

*Production of crude petroleum in New Mexico, 1940-44, by districts and fields*¹

[Thousands of barrels]

Year	Southeast									North west	Total
	Arrow-head	Eunice	Gray-burg-Jackson	Hobbs	Loco Hills	Malja-mar and South	Monu-ment	Vacuum	Other		
1940.....	916	6,561	1,773	3,785	1,959	760	6,887	4,738	11,124	254	38,757
1941.....	1,429	6,658	1,627	3,686	2,308	1,651	6,960	4,900	10,335	206	39,660
1942.....	1,195	5,242	1,566	2,928	1,583	1,740	6,688	3,443	8,317	280	32,992
1943.....	1,703	6,498	1,914	3,780	1,296	1,853	7,190	4,953	9,312	425	38,924
1944.....	1,946	6,470	1,983	4,120	1,119	2,117	7,570	5,080	8,896	448	39,751

¹ Oil and Gas Journal.

New York.—Production declined from 5,059,000 barrels in 1943 to 4,697,000 in 1944, the lowest level since 1936.

According to Oil Weekly, oil-well completions totaled 781 in 1943 and 788 in 1944, and water-input wells totaled 442 and 446, respectively. Efforts to develop new shallow production or to extend known producing areas met with little success.

Effective August 1, 1944, a subsidy of 75 cents per barrel was granted by the Office of Price Administration for all Pennsylvania-Grade crude oil.

Production of crude petroleum in New York, 1940-44, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1940.....	458	430	438	444	439	402	425	396	383	408	379	397	4,999
1941.....	424	372	410	436	435	422	456	438	445	465	414	468	5,185
1942.....	453	405	454	458	455	467	474	456	459	461	425	454	5,421
1943.....	418	389	453	427	432	436	438	429	423	403	401	410	5,059
1944 ¹	387	381	399	375	419	402	332	480	392	393	376	361	4,697

¹ Subject to revision.

Ohio.—Production continued the decline that has been common to all the old eastern areas, amounting to 2,937,000 barrels in 1944 compared with 3,322,000 in 1943. All grades of oil shared in the decline, with Lima falling most (about 37 percent). Pennsylvania-Grade production declined from 1,719,000 barrels in 1943 to 1,525,000 in 1944.

According to Oil Weekly, oil-well completions numbered 210 in 1944 and 152 in 1943. The most active counties, with the number of

oil wells completed in each, were: Perry 40, Muskingum 16, Licking 14, Monroe 13, and Washington 12. Oil completions by principal producing formations were: Clinton 67, Berea 53, and Shallow sands 36. Development of the Berea was curtailed sharply after 1941, but Clinton-sand oil completions have remained above the 1940 level, chiefly because of active exploitation of the rich Clayton pool, Perry County.

Additions to oil reserves were limited to a few minor extensions to existing fields. Two outpost wells in Pike township, Coshocton County, may stimulate further drilling.

The subsidy payment to producers, granted by the Office of Price Administration effective August 1, 1944, was 75 cents a barrel for Pennsylvania-Grade oil and 35 cents for all other grades produced in Ohio. This extra income is expected to encourage operators to expand secondary recovery activity.

Production of crude petroleum in Ohio, 1940-44, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1940	207	234	246	264	280	260	286	287	272	296	248	279	3,159
1941	278	255	273	294	300	297	298	286	300	316	289	324	3,510
1942	277	262	296	317	297	322	319	297	300	308	280	268	3,543
1943	253	244	293	273	278	285	286	303	278	274	276	279	3,322
1944 ¹	253	232	263	229	276	247	190	295	240	257	237	218	2,937

¹ Subject to revision.

Oklahoma.—The long decline in production was reversed in 1944, when 124,616,000 barrels were reported compared with 123,152,000 barrels in 1943. The greatest addition of new oil was from West Edmond, which rapidly expanded into a major field, producing 7,752,000 barrels in 1944 compared with only 322,000 in 1943. Paul's Valley added over 2.2 million barrels to its output in 1944, and other notable gains were recorded at Cumberland, Cement, and the Glenn pool-Sapulpa area, where secondary recovery operations are becoming a large factor.

As in other recent years, the largest declines were in the Oklahoma City field and the Seminole district, which produced 4.0 million and 2.7 million barrels less, respectively, in 1944 than in 1943. Material declines elsewhere were in Osage County, Bristow-Slick, and Nowata County.

Oil-well completions increased from 543 in 1943 to 1,031 in 1944, reflecting 256 completions at West Edmond compared with 11 in 1943. Other active fields, with 1944 oil-well completions, were: Loco and West 55, Velma and North 51, Paul's Valley and East 50, Cumberland 27, Glenn 26, Cement 24. Wildcat drilling increased in 1944 and was most active in Garvin, Hughes, Lincoln, Stevens, and Carter Counties.

About 40 new pools were opened in 1944, several of which may develop into important producers, but the reserves added by expansion of the West Edmond field dwarfed other operations, so far as presently known potentialities are concerned. By the end of the year West Edmond covered over 14,000 acres proved for Hunton limestone production, and a few wells were producing from Bartlesville sand. Trade reports indicate that about 165,000,000 barrels of new oil were proved in this field in 1944.

An important group of deep fields was opened in McClain and Cleveland Counties on the west flank of the Nemaha granite ridge—Moore West and South, West Noble, and Washington. Production was obtained from the Bartlesville sand, Bromide, and Second Wilcox sand. Although several million barrels of oil are indicated, more wells will be required to determine the size of these fields. Their presence, however, has encouraged prospecting in the great Anadarko basin.

Farther south, in Garvin County, the East Paul's Valley field was discovered in April, production being from a Pennsylvanian sand at 2,960–2,984 feet. Thirty-two producing wells were drilled in 1944, and active development continued in 1945. The Hoover Northwest pool, also in Garvin County, was opened in May by a well that produced 120 barrels per day from a Pennsylvanian sand between 1,107 and 1,120 feet. Two additional sands, at about 1,400 and 1,960 feet, were proved for production. At the end of the year, 14 wells were producing. The seismograph was instrumental in finding both of these fields.

In T. 10 N, R. 7 E, Seminole County, Booch sand production was found at 3,429–3,441 feet to open the Cheyarha pool. Sixteen oil wells were drilled in 1944 in this pool, and three were drilling in January 1945.

Production of crude petroleum in Oklahoma, 1940–44, by fields ¹

(Thousands of barrels)

Field	1940	1941	1942	1943	1944
Allen.....	2,066	1,780	1,365	1,245	1,285
Apache.....	.....	274	1,740	2,309	2,245
Boebe.....	1,828	1,526	1,152	1,057	840
Billings.....	2,209	2,276	2,064	1,706	1,490
Bristow-Slick.....	2,213	1,951	1,777	1,658	785
Burbank.....	2,838	3,282	3,356	3,251	3,140
Cement.....	2,469	3,354	3,211	2,564	4,190
Coyle.....	637	1,468	1,660	1,627	1,185
Crescent.....	769	576	752	752	1,124
Cromwell.....	1,357	1,457	2,380	1,761	1,512
Cumberland.....	393	2,543	2,776	3,735	4,414
Cushing-Shamrock.....	3,353	3,223	3,069	2,991	2,940
Edmond.....	1,488	1,224	1,136	1,161	1,046
Fish.....	1,153	1,359	923	700	588
Fitts.....	6,246	4,223	3,050	2,489	2,150
Glenn-Sapulpa.....	1,459	1,483	1,527	1,856	2,245
Healdton.....	3,177	3,086	2,827	2,618	2,515
Hewitt.....	1,778	4,860	3,304	2,382	2,055
Keokuk.....	1,091	1,029	1,012	678	560
Lucien.....	2,750	2,067	1,877	1,575	1,363
Nowata County.....	4,306	3,995	3,787	3,039	2,690
Oklahoma City.....	35,970	32,184	26,484	20,338	16,295
Osage (outside Burbank-South Burbank).....	5,904	6,131	4,716	4,918	4,065
Paul's Valley.....	.....	.....	823	1,963	4,200
Ramsey.....	1,377	1,549	1,664	1,590	1,250
Seminole field:					
Bowlers.....	2,464	2,134	1,900	1,721	1,525
Carr City.....	840	791	662	602	555
Earlsboro.....	3,730	3,757	3,718	3,253	2,495
Konawa.....	766	1,245	670	521	465
Little River.....	2,875	2,705	2,333	1,931	1,741
St. Louis-Pearson.....	9,331	6,997	5,687	3,828	2,690
Seminole City.....	2,501	2,243	2,854	2,555	2,240
Other Seminole districts.....	4,482	3,815	2,584	2,188	2,206
Total Seminole field.....	26,989	23,687	20,408	16,599	13,917
Sholem-Alechem-Tatums-Tussey.....	2,169	2,826	2,490	2,275	2,486
South Burbank.....	2,227	2,780	2,728	2,637	2,594
West Edmond.....	.....	.....	.....	322	7,752
Other fields.....	31,851	37,064	32,703	28,763	30,609
Total Oklahoma.....	150,767	153,257	136,761	120,569	123,436

¹ Oil and Gas Journal.

Several wildcats were drilled in the western part of the State, of which two found oil. In southwestern Washita County, a well drilled to 9,971 feet was plugged back and produced 307 barrels of oil from granite wash at 5,540 feet. In northern Kiowa County, a large well was completed in the Springer formation at 1,728 feet.

Pennsylvania.—Production of 14,118,000 barrels in 1944 was 10 percent below 1943 and 21 percent below the recent high recorded in 1942. Output of the Bradford field, which dominates Pennsylvania production, declined 11 percent to 12.1 million barrels.

Drilling for oil, related almost exclusively to secondary recovery projects, was notably higher than in 1943, doubtless influenced by the subsidy payment of 75 cents a barrel granted producers to counteract higher operating costs. According to Oil Weekly, 1,410 oil wells and 1,268 input wells were drilled in 1944, compared with 1,122 and 1,104 in 1943.

No new oil was discovered in 1944. Of 12 deep wildcats drilled to the Onondaga or below, one in Mercer township, Butler County, was sunk to 10,096 feet. It was bottomed in a salt-water-bearing sandstone below 520 feet of Lower Ordovician dolomite (probably Beekmantown) in which a show of gas was encountered.

Disappointing results were reported from the oil-mining shaft at Franklin. Three pairs of radial holes have been drilled, but apparently recovery of oil is not great in relation to development costs.

Production of crude petroleum in Pennsylvania, 1940-44, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1940.....	1,522	1,505	1,530	1,582	1,585	1,335	1,418	1,387	1,321	1,405	1,319	1,444	17,333
1941.....	1,416	1,231	1,336	1,382	1,407	1,345	1,419	1,376	1,440	1,501	1,370	1,527	16,750
1942.....	1,501	1,332	1,518	1,582	1,522	1,500	1,526	1,508	1,481	1,502	1,359	1,388	17,779
1943.....	1,358	1,229	1,419	1,348	1,367	1,368	1,359	1,330	1,290	1,246	1,228	1,215	15,757
1944.....	1,202	1,149	1,264	1,183	1,292	1,206	1,032	1,367	1,160	1,151	1,098	1,014	14,118

¹ Subject to revision.

Texas.—Production of 748,122,000 barrels was 153,779,000 barrels above the record of 1943 and equalled 44.6 percent of the United States total, compared with 39.5 percent in 1943. For the second successive year, higher output was reported from all districts as pressure upon the industry for a greater volume of production for war activities continued throughout the year. The greatest district gains were as follows: West Texas 61,786,000 barrels, Gulf Coast 60,996,000, East Texas 12,345,000, and South Texas 12,213,000. These districts, except the Gulf Coast, supplied the crude that the 24-inch war-emergency pipe line transported to refineries on the East Coast.

Drilling activity was 30 percent above the low level of 1943, and oil-well completions increased 49 percent to 3,526. All of the net increase was in the West Texas and Gulf districts, where active development in a number of large fields was carried on. East Texas had fewer new oil wells than in 1943, and the rest of the State only 21 more.

Many fields contributed to the 30-percent increase in Gulf Coast production to a new record of 261,124,000 barrels in 1944. The same

leading fields as in 1943 reported the largest individual gains and maintained their relative positions in the following order: Conroe, Hastings, Friendswood, Thompsons, and Anahuac. Important gains were scored by several of the newer fields that have been extensively developed during the past 2 years, particularly Stowell, Stratton, and Fig Ridge.

A marked increase in drilling resulted in 804 oil well completions compared with only 245 in 1943. The increased activity was directed chiefly toward development of existing fields, as indicated by the modest gain in the number of dry holes to 1,935 in 1944 from 1,908 in 1943. The following were the fields of greatest development in 1944, with the number of oil wells drilled in each: Seeligson 79, Willamar 53, Slick-Wilcox 30, Fig Ridge 29, and Stratton 27.

More than 60 new fields or pools were opened on the Gulf Coast in 1944, most of which were concentrated in the belt of counties from Brooks on the south to Colorado and Wharton on the north. In the upper Coast section the new fields were reported to be of minor size, the most important of which may be the Smith's Point field, Chambers County, in which four wells producing from the Frio formation were drilled before the year end. Discouragements in the form of dry holes followed several of the other discoveries.

In the lower Coast district, two oil fields were discovered along the Cretaceous fault-line trend in Guadalupe and Zavala Counties, and five oil fields were discovered in the Wilcox trend.

In the Jackson-Yegua trend, there were 8 oil discoveries, and a number of important additions were made to known fields. Of 12 oil fields opened along the Frio-Vicksburg trend, the Canales and Tijerina fields in Jim Wells County and the East Alta Mesa and Scott and Hopper fields, Brooks County, are reported to have major potentialities. Discoveries in the lower Rio Grande Valley appeared to be limited to gas reserves.

West Texas production continued to increase to a peak of 505,700 barrels daily in September 1944, reflecting the added carrying capacity of two new pipe lines that went into service early in the year and emergency tank-car movements of the crude northeastward and to the Pacific coast. The output from all major fields gained sharply, led by Gaines-Yoakum, which more than doubled its yield to 33,785,000 barrels. Other outstanding gains were reported by the Slaughter field, Ector County fields, and Pecos County.

Stimulated by important recent discoveries and the mounting withdrawals of oil, drilling increased sharply over 1943, and 1,323 oil wells were completed compared with 717 in 1943. Development was concentrated in the Slaughter field that had 372 oil-well completions. Other very active fields were Fullerton (114 oil wells completed), North Cowden (75), Wasson (58), and Fuhrman-Masco (58). All the above fields were among the leaders in development in 1943 also.

Exploratory drilling, at almost double the rate of 1943, resulted in 15 new fields, of which 10 produced from the Permian, 3 from Devonian, and 2 from the Ellenburger. Growing emphasis was placed upon testing the deep formations below the Permian. The first oil from rocks of Devonian age in the Permian Basin was found in August in the Crossett pool, Crane County, at a depth of 5,300 to 5,390 feet. Four wells were completed in this pool in 1944. Two other Devonian

discoveries, both considered important, followed. The first, also completed in August, was drilled $1\frac{1}{2}$ miles south of production in the Fullerton field, Andrews County. It flowed 3,744 barrels from Devonian below 8,260 feet. The TXL field, Ector County, was opened in December 1944 by a large well flowing from Devonian dolomite at 7,886 to 8,050 feet. Drilling early in 1945 indicates that this field contains a major oil reserve.

Ellenburger discoveries were made in Crane County, 5 miles north-east of the Sand Hills field (at 5,800 feet) and in Crockett County on the Todd structure (at 6,142 feet). Important extensions of Ellenburger production were developed in the Keystone and Wheeler fields, Winkler County.

The East Texas district produced 185,170,000 barrels of oil in 1944 (7 percent more than in 1943), of which 135,121,000 barrels were from the East Texas field. The outstanding gain in output was from the Van field, which produced 6,411,000 barrels in 1943 and 12,168,000 in 1944. This field is almost completely controlled by a single company and has been operated efficiently and conservatively for a number of years.

The number of oil-well completions in the East Texas district continued to decline to 124 in 1944 from 157 in 1943. No drilling was done in the East Texas field, and 476 wells were abandoned. The most active fields were Newhope, Franklin County, and Weiland, Hunt County, with 23 oil wells each, and Manziel, Wood County, with 18.

Nine oil fields were discovered in 1944, five of which produced from lower Glen Rose or Travis Peak horizons. The largest appear to be Winnsboro in Wood County, producing from two limestones of the Rodessa series, and Sand Flat in Smith County, producing from the Paluxy. The development of two new producing formations at Newhope, in the Glen Rose and Travis Peak formations, indicated substantial additional reserves.

Moderate gains in production were reported in North and Central Texas in 1944. Drilling increased about 18 percent and resulted in 850 oil wells. The Hildreth field, Montague County, with 66 new oil wells, was the most active in 1944, and important extensions of its productive area were made. The discovery of 50-odd fields or pools was indicated; none of them promised to be large. Discoveries or extensions were developed in the Cisco, Canyon, Strawn, Bend, Mississippian, and Ordovician series.

Panhandle production of 33,435,000 barrels in 1944 was little changed from 1943. No extensions or discoveries of oil production were reported, and only 12 wildcat wells were drilled. Oil-well completions increased from 148 in 1943 to 227 in 1944, of which 95 were in Gray County, 87 in Hutchinson, and 42 in Carson.

Production of crude petroleum in Texas, 1940-44, by districts and fields

[Thousands of barrels]

District and field	1940	1941	1942	1943	1944 ¹
Gulf Coast:					
Agua Dulce.....	128	714	795	1,904	3,511
Amelia.....	894	1,220	1,375	1,668	1,682
Anahuac.....	2,683	4,657	3,589	8,006	11,932
Barbers Hill.....	3,180	3,076	2,879	2,340	2,069
Bay City.....	1,159	783	589	1,222	1,761
Clear Lake.....	377	605	647	1,468	1,872
Conroe.....	9,303	11,630	13,514	19,967	23,231
Dickinson-Gillock.....	2,940	2,191	2,073	2,128	2,377
Fairbanks.....	2,460	2,932	2,784	2,802	2,910
Fannette.....	184	457	457	1,242	1,657
Fig Ridge.....	12	41	237	862	2,516
Flour Bluff.....	1,151	1,336	426	1,009	1,490
Friendswood.....	2,542	2,959	3,615	11,420	20,930
Goose Creek.....	571	509	484	388	414
Greta.....	1,493	2,357	1,132	1,490	3,375
Hardin.....	1,646	1,659	1,091	1,372	1,330
Hastings.....	5,421	7,623	10,412	17,964	22,169
Heyser.....	3,399	2,633	2,926	3,337	3,338
High Island.....	966	985	880	805	839
Hull.....	2,005	2,387	2,217	1,879	1,645
La Rosa.....	1,245	1,058	365	676	1,681
Lolita.....	215	1,454	2,269	1,887	2,146
Lovell's Lake.....	882	1,334	1,784	2,040	1,891
Luby.....	1,459	1,396	782	1,276	1,581
Marvel.....	2,627	1,915	1,906	2,665	3,024
Markham.....	363	455	531	973	2,409
Old Ocean.....	4,165	4,741	3,701	4,785	5,517
Oyster Bayou.....	-----	37	134	1,222	2,267
Placedo.....	1,882	1,401	1,228	1,730	2,265
Raccoon Bend.....	1,232	1,329	1,587	2,646	3,675
Refugio.....	2,111	2,223	1,542	1,509	1,839
Saxet-Saxet Heights.....	5,634	4,578	2,728	2,677	2,685
Segno.....	1,606	1,538	1,290	1,599	1,394
South Houston.....	638	788	667	1,586	1,865
Stowell.....	-----	2	257	1,747	5,522
Stratton.....	41	754	683	1,732	4,090
Sugarland.....	1,354	647	614	1,779	3,084
Thompsons.....	4,384	4,609	5,392	9,993	13,609
Tomball.....	2,675	3,314	3,146	3,257	3,781
West Columbia.....	2,353	2,740	1,984	2,041	2,584
West Ranch.....	1,862	3,691	5,249	6,762	8,102
White Point.....	3,054	2,864	2,934	3,905	4,537
Withers-Magnet.....	1,712	2,829	4,165	6,016	6,749
Other Gulf Coast.....	* 38,158	* 38,281	* 37,960	* 51,444	* 63,779
Total Gulf Coast.....	122,166	134,732	135,020	200,128	261,124
East Texas:					
East Texas proper ²	141,023	132,486	122,799	129,983	135,121
Cayuga.....	4,432	4,303	4,066	3,469	2,998
Chapel Hill.....	231	480	979	1,293	1,245
Hawkins.....	-----	1,432	5,451	14,243	13,178
Long Lake.....	828	1,342	1,463	1,558	1,995
Quitman.....	-----	-----	3	642	2,083
Rodessa.....	6,607	4,712	3,166	2,821	2,209
Sulphur Bluff.....	1,522	1,582	1,549	1,510	1,426
Talco.....	8,818	9,038	9,522	9,266	8,618
Van.....	4,512	3,739	3,444	6,411	12,168
Other East Texas.....	946	846	840	1,639	4,129
Total East Texas.....	168,919	159,960	153,282	172,825	185,170
Central Texas:					
Darst Creek.....	2,178	1,845	2,220	2,779	3,438
Luling.....	2,256	1,974	1,754	1,645	1,551
Mexia-Powell ⁴	1,418	1,531	1,480	1,339	1,290
Salt Flat (Bruner).....	1,512	1,348	1,118	909	817
Other Central Texas.....	3,064	2,897	1,954	2,760	5,415
Total Central Texas.....	10,428	9,595	8,526	9,432	12,511
North Texas ⁵	* 48,153	* 48,529	* 49,932	* 50,159	* 53,379
Panhandle ⁷	26,716	27,831	30,881	33,295	33,435
South Texas ⁸	32,333	32,018	23,681	29,285	41,498

See footnotes at end of table.

Production of crude petroleum in Texas, 1940-44, by districts and fields—Con.

[Thousands of barrels]

District and field	1940	1941	1942	1943	1944 ¹
West Texas:					
Andrews County.....	1,506	2,224	1,345	2,008	7,120
Big Lake.....	2,075	1,938	1,839	1,762	1,531
Crane-Upton.....	10,389	9,920	9,628	11,598	17,028
Crockett.....	574	827	919	1,187	1,460
Ector ²	20,142	23,486	16,132	20,303	33,635
Fisher.....	835	655	572	475	434
Gaines-Yoakum.....	12,066	15,731	11,530	15,785	33,785
Glasscock-Howard-Mitchell.....	7,842	7,202	7,165	7,008	7,332
Pecos.....	9,593	8,391	9,808	12,288	16,785
Slaughter.....	841	4,612	7,403	11,267	23,222
Ward.....	7,580	7,189	5,890	5,734	7,153
Winkler.....	10,324	9,962	8,690	8,921	9,712
Other West Texas.....	707	770	854	883	1,790
Total West Texas.....	84,494	92,907	81,775	99,219	161,005
Total Texas.....	493,209	505,572	483,097	594,343	748,122

¹ Subject to revision.² Includes crude oil consumed on leases and net change in stocks held on leases for entire district.³ Joiner, Kilgore, Lathrop, and other pools in Cherokee, Gregg, Rusk, Smith, and Upshur Counties.⁴ Includes other fields in Falls, Freestone, Limestone, and Navarro Counties.⁵ Includes the fields in and between Wilbarger, Wichita, Clay, Montague, and Cooke Counties on the north and Runnels, Coleman, Brown, and Comanche Counties on the south.⁶ Includes crude oil consumed on leases and net change in stocks held on leases for East (exclusive of East Texas proper) Central, North, and South Texas.⁷ Carson, Gray, Hutchinson, Moore, and Wheeler Counties.⁸ Includes fields in Brooks, Duval, Hidalgo, Jim Hogg, Jim Wells, LaSalle, Live Oak, McMullen, Starr Webb, and Zapata Counties.⁹ Includes the part of Jordan pool in Crane County.

West Virginia.—Production in 1944 of 3,070,000 barrels compared with 3,349,000 barrels in 1943, a reduction of 8 percent.

According to David B. Reger, Morgantown, W. Va., 71 oil wells were drilled in 1944 with an average initial daily production per well of 8.6 barrels. The most active counties, with oil-well completions in each, were: Roane 11, Calhoun 8 (5 in Sycamore pool), Clay 6 (all in Reed Fork pool), Ritchie 5, and Wetzel 5.

No oil discoveries were made. Drilling for oil was limited to inside locations and two or three marginal operations of little consequence. The subsidy payment to producers of 75 cents a barrel, granted as of August 1, 1944, by the Office of Price Administration, had no apparent effect upon field activity.

Production of crude petroleum in West Virginia, 1940-44, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1940.....	234	301	285	300	311	276	303	291	286	312	264	281	3,444
1941.....	286	249	276	300	290	280	297	283	289	311	270	302	3,433
1942.....	294	267	310	313	297	306	306	305	310	321	267	278	3,574
1943.....	296	261	295	285	272	298	281	278	274	278	264	267	3,349
1944 ¹	259	254	270	249	280	258	224	293	252	264	248	219	3,070

¹ Subject to revision.

Wyoming.—Production declined 5 percent to 32,388,000 barrels in 1944. Reduced output was reported from most fields, particularly in the black-oil production of Oregon Basin and at Lost Soldier,

Lance Creek, and Grass Creek. As in 1943, the largest gain was at Elk Basin, which responded to further development of its great reserve of oil in the Tensleep sand and to improved transportation facilities. At Steamboat Butte, a 1943 discovery, output almost tripled to 601,000 barrels. Smaller increases were recorded at Frannie, Big Muddy, and Cole Creek.

Oil-well completions totaled 167 in 1944 and 102 in 1943. Major development was at Elk Basin, with 46 new wells, and Oregon Basin, with 33. Ten wells were drilled in the Byron field and 10 in the Garland field, whose known reserves were greatly increased.

Exploratory drilling resulted in 18 discoveries and several important extensions to known producing fields. The opening of production in the Embar lime and Tensleep sand at Big Sand Draw, Fremont County, revealed great potential reserves. Other important new reserves were found in the Tensleep sand at Gebo Dome, Hot Springs County; Little Buffalo Basin, Park County; Spindletop, Natrona County; and Steamboat Butte and Winkleman, Fremont County. At Garland Dome, a major extension of Tensleep production was made and lesser extensions at Fourbear and Pitchfork, Park County.

Sundance production was developed at Bailey, Carbon County, and Lakota sand oil was discovered at Crook's Gap and Steamboat Butte, Fremont County. Production from the Embar formation was opened at Big Sand Draw, Half Moon, and Kirby Creek; and Muddy sand oil at Golden Eagle, Mush Creek, and North Big Hollow.

The capacity to produce oil in Wyoming is evidently much above the ability of available transportation and refining facilities to process it economically for consumption.

Production of crude petroleum in Wyoming, 1940-44, by fields

[Thousands of barrels]

Year	Big Muddy	Byron-Garland	Cole Creek	Elk Basin	Frannie	Grass Creek	Hamilton Dome-Warm Springs	La Barge	Lance Creek	Lost Soldier-Ferris-Wertz
1940.....	429	1,411	65	190	812	718	353	585	9,121	2,070
1941.....	421	1,516	295	195	939	1,171	264	767	8,838	4,745
1942.....	402	2,163	372	156	1,013	1,524	445	767	7,857	5,118
1943.....	382	2,554	414	2,133	846	1,313	508	655	7,082	4,246
1944 ¹	504	2,534	514	2,885	1,092	993	443	585	6,535	3,441

Year	Maverick Springs	Medicine Bow	Oregon Basin	Pilot Butte	Poison Spider-South Casper	Rock Creek	Salt Creek	Steamboat Butte	Other fields	Total
1940.....	12	251	2,725	2	238	928	5,201	-----	† 600	25,711
1941.....	490	245	3,197	2	251	952	5,146	-----	† 444	29,878
1942.....	750	231	4,711	175	236	933	5,004	-----	† 955	32,812
1943.....	506	229	5,345	464	262	911	4,820	219	† 1,304	34,253
1944 ¹	474	208	4,388	370	229	935	4,802	601	† 865	32,388

¹ Subject to revision.

[†] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.

Other States.—Five wildcat wells were drilled in Atchison and Holt Counties, Mo., but no oil was discovered. Development of the Tarkio pool, Atchison County, discovered in early 1943, continued and production exceeded 1,000 barrels per month. Missouri's total production in 1944 was about 45,000 barrels.

In Tennessee, several major companies are reported to have leased large areas of the Cumberland Plateau district with the intent of exploring the possibilities of pre-Mississippian production. One Ordovician test was started in Cumberland County.

Virginia produced 2,200 barrels of oil in 1944 from two Trenton limestone wells in the Rose Hill field, Lee County.

Wildcat drilling or leasing were reported in Georgia (six dry holes), Maryland (one dry hole), North Carolina (one test drilling), South Carolina, Arizona (six dry holes), Iowa (two dry holes), Utah (one dry hole), North and South Dakota, Washington, and Oregon.

WELLS

The number of wells drilled in the United States in 1944, including oil and gas wells and dry holes, rose from 17,884 in 1943 to 23,106 in 1944. The increased number of wells drilled reflects the need for further exploration and the discovery of new reserves to meet the rapid rise in production to meet war requirements and to insure an adequate supply after the war.

Oil-well completions rose from 9,717 in 1943 to 13,029 in 1944; the number of gas wells completed increased from 1,897 in 1943 to 3,065 in 1944; and the number of dry holes was 6,270 in 1943 compared with 7,012 in 1944. The total number of wells drilled in the first 6 months of 1944 was 10,472 compared with 12,634 in the latter half of the year.

Wells drilled for oil and gas in the United States, 1943-44, by months¹

Wells	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
													Number	Per cent
1943														
Oil.....	683	635	701	764	717	793	853	824	954	919	952	922	9,717	54.3
Gas.....	119	126	155	134	141	160	144	160	195	176	183	204	1,897	10.6
Dry.....	418	351	434	457	499	539	554	625	675	538	588	592	6,270	35.1
	1,220	1,112	1,290	1,355	1,357	1,492	1,551	1,609	1,824	1,633	1,723	1,718	17,884	100.0
1944														
Oil.....	784	948	974	982	1,041	1,184	1,120	1,209	1,357	1,191	1,139	1,100	13,029	56.4
Gas.....	217	196	219	205	228	263	253	271	323	284	325	281	3,065	13.3
Dry.....	473	511	501	550	560	636	630	646	694	611	605	595	7,012	30.3
	1,474	1,655	1,694	1,737	1,829	2,083	2,003	2,126	2,374	2,086	2,069	1,976	23,106	100.0

¹ Oil and Gas Journal east of California; American Petroleum Institute in California.

An active drilling campaign was continued in California, where the total wells drilled rose from 1,447 in 1943 to 2,034 in 1944. The number of oil-well completions increased from 1,150 in 1943 to 1,663 in 1944. The number of wells drilled in Kentucky rose from 656 in 1943 to 993 in 1944—an increase of 337. This drilling resulted in the completion of 374 oil wells in 1944 compared with 243 in 1943. Drilling was particularly active in Oklahoma, where the total number of wells drilled increased from 1,184 in 1943 to 1,890 in 1944, and the number of oil-well completions rose from 543 in 1943 to 1,031 in 1944. The total number of wells drilled in Texas increased from 4,421 in 1943 to 5,729 in 1944, and oil wells completed rose from 2,373 in 1943 to 3,526 in 1944. The drilling of 5,410 new wells in Pennsylvania, New York, Ohio, and West Virginia resulted in the completion of 2,681 oil wells and 1,882 gas wells.

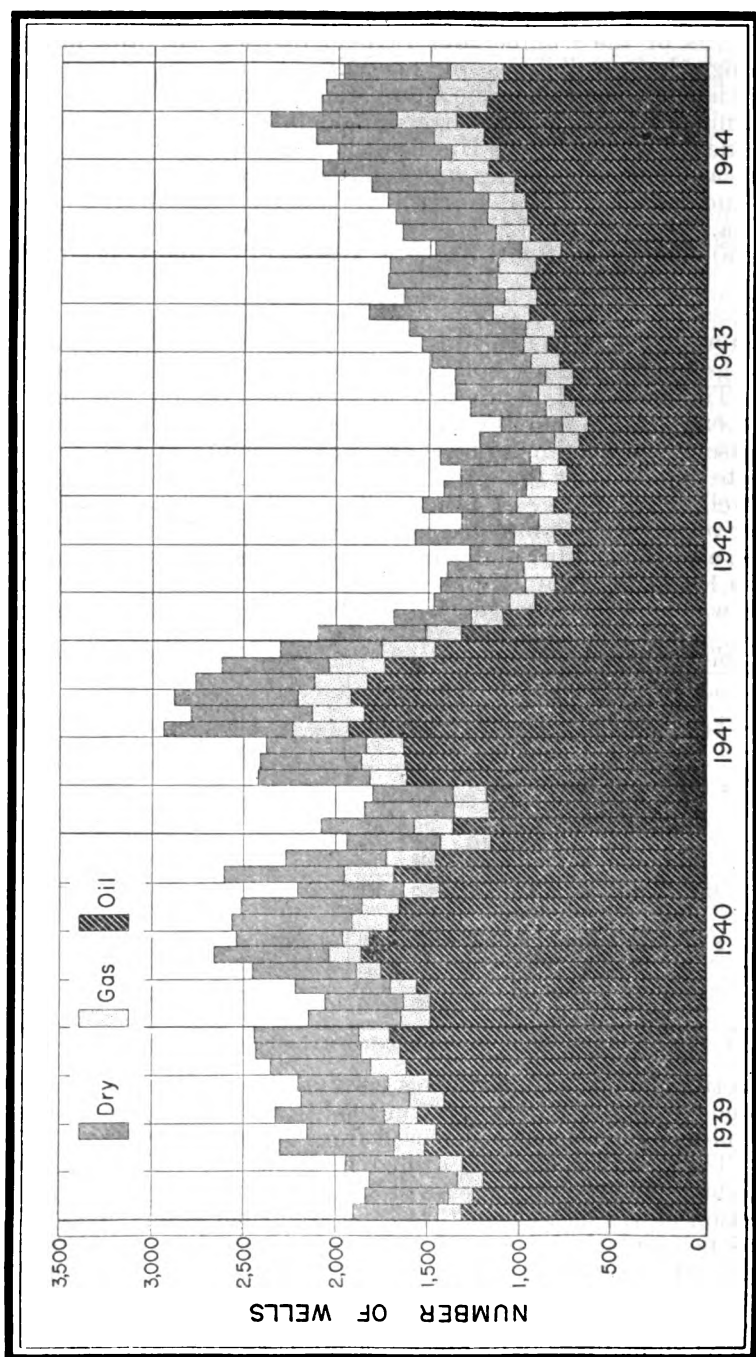


FIGURE 4.—Wells drilled in the United States, 1939-44, by months.

Wells drilled for oil and gas in the United States, 1943-44, by States and districts ¹

State and district	1943				1944			
	Oil	Gas	Dry	Total	Oil	Gas	Dry	Total
Arkansas.....	137	3	103	243	128	2	85	215
California.....	1,150	30	267	1,447	1,063	48	323	2,034
Colorado and Utah.....	11	1	19	31	22	1	14	37
Illinois.....	1,046	12	663	1,751	1,196	6	747	1,949
Indiana.....	96	11	140	247	144	22	137	303
Kansas.....	880	36	819	1,735	824	83	920	1,837
Kentucky.....	243	162	251	656	374	305	314	993
Louisiana:								
Gulf Coast.....	210	13	137	360	310	15	149	474
Northern.....	126	59	128	313	119	67	143	329
Total Louisiana.....	336	72	265	673	429	82	292	803
Michigan.....	235	47	346	628	239	59	357	655
Mississippi.....	31	-----	84	115	78	1	77	156
Montana.....	148	27	65	240	221	63	103	387
Nebraska, Missouri, and Iowa.....	7	-----	35	42	12	3	18	33
New Mexico.....	182	7	62	251	263	15	116	414
Oklahoma.....	543	92	549	1,184	1,031	212	647	1,890
Pennsylvania, New York, Ohio, and West Virginia.....	2,194	1,250	601	4,045	2,681	1,882	847	5,410
Texas:								
Gulf Coast.....	245	24	244	513	804	128	469	1,401
East Texas.....	157	14	139	310	124	29	155	308
West Texas.....	717	6	168	891	1,323	15	244	1,582
Rest of State.....	1,254	96	1,357	2,707	1,275	96	1,067	2,438
Total Texas.....	2,373	140	1,908	4,421	3,526	268	1,935	5,729
Wyoming.....	102	6	25	133	167	5	33	205
Other States.....	3	1	38	42	11	-----	45	56
Total United States.....	9,717	1,897	6,270	17,884	13,029	3,067	7,010	23,106

¹ Oil and Gas Journal east of California; American Petroleum Institute in California.*Producing oil wells in the United States and average production per day in 1943, by States and districts ¹*

State and district	Producing oil wells		State and district	Producing oil wells	
	Approximate number, Dec. 31	Average production per well per day (barrels)		Approximate number, Dec. 31	Average production per well per day (barrels)
Arkansas.....	3,150	24.2	New York.....	22,450	.6
California ¹	19,700	40.7	Ohio.....	23,000	.4
Colorado.....	210	30.3	Oklahoma.....	53,100	6.4
Illinois.....	24,000	9.4	Pennsylvania.....	82,800	.5
Indiana.....	2,000	7.4	Texas:		
Kansas.....	23,100	12.5	Gulf Coast.....	13,500	42.0
Kentucky.....	15,000	1.4	East Texas proper.....	16,100	17.3
Louisiana:			West Texas.....	25,100	14.2
Gulf Coast.....	3,150	85.0	Rest of State.....	46,100	9.7
Northern.....	4,100	18.8	Total Texas.....	100,800	16.2
Total Louisiana.....	7,250	47.7	West Virginia.....	16,900	.5
Michigan.....	3,380	17.0	Wyoming.....	3,710	25.5
Mississippi.....	370	143.1	Other States ²	110	1.3
Montana.....	2,070	10.5	Total wells.....	407,170	10.2
Nebraska.....	90	19.3			
New Mexico.....	3,980	27.2			

¹ Figures for 1944 not yet available.² American Petroleum Institute.³ Florida, Missouri, Tennessee, and Virginia.

STOCKS

Total stocks of crude petroleum amounted to 226,969,000 barrels on December 31, 1944, compared with 249,404,000 barrels on January 1, 1944. Stocks of foreign crude increased by 1.1 million barrels during the year, and stocks of domestic origin declined by 23.5 million barrels. The principal changes in stocks of domestic crude by States of origin were declines of 10.7 million barrels for all grades of California crude, 6.2 million barrels for Texas, and 4.5 million for Wyoming.

Total crude-oil stocks declined about 47 million barrels in the 4-year period from the end of 1940 to the end of 1944. The major decreases by States of origin were 33 million barrels for Oklahoma, 19 million barrels for California, 8 million barrels for Wyoming, and 7 million barrels for Illinois. The only large increase was 25 million barrels for Texas.

Stocks of crude petroleum, natural gasoline, and refined products in the United States at end of year, 1940-44

[Thousands of barrels]

Product	1940	1941	1942	1943	1944 ¹
Crude petroleum (refinable):					
At refineries.....	52,448	51,319	43,620	47,719	48,576
Pipe line and tank farm.....	200,726	183,992	177,904	181,422	158,181
Producers.....	11,535	12,188	13,365	{ 12,991 }	14,106
Total refinable.....	264,709	247,499	234,889	{ 243,506 242,132 8,289 7,272 }	220,862
California heavy crude.....	11,906	10,179	10,865	{ 8,289 7,272 }	6,107
Total crude petroleum.....	276,615	257,678	245,754	{ 251,795 249,404 }	226,969
Natural gasoline.....	5,704	{ 4,275 4,437 }	4,632	4,541	4,262
Refined products ²	280,958	{ 290,375 294,310 }	247,554	229,362	245,868
Grand total.....	563,277	{ 552,328 556,425 }	497,940	{ 485,698 483,307 }	477,089

¹ Final figures.

² For comparison with succeeding years.

³ Includes equivalents for wax, coke, and asphalt in barrels.

Changes in the stocks of refined products indicate the adequacy of crude-oil supply. Total stocks of refined oils rose from about 229 million barrels at the end of 1943 to 246 million at the end of 1944—a gain of almost 17 million barrels during 1944 compared with a decline of 18 million barrels in 1943. This improvement in the stock situation resulted from improved transportation facilities to distribute both crude and products and to the upward trend in production of crude. The decline in refined stocks in 1943 primarily took place in California, whereas the increase in 1944 was all in areas east of California.

Stocks of crude petroleum in the United States in 1944, by States of location and by months
 [Thousands of barrels]

State	Jan. 1	Jan. 31	Feb. 29	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
LOCATION													
Arkansas.....	2,991	3,045	3,018	3,055	3,040	3,008	3,027	3,131	3,032	2,968	3,053	2,765	2,926
California and Washington.....	29,836	28,068	26,718	25,037	23,710	23,634	22,238	21,946	22,221	22,592	22,077	20,817	20,302
Colorado.....	77	455	427	385	372	371	432	433	439	452	361	412	404
Georgia, Florida, South Carolina, and Virginia.....	15,258	14,375	14,454	14,177	13,371	13,004	12,966	13,356	13,425	13,819	13,783	13,709	14,390
Illinois, Minnesota, and Wisconsin.....	3,795	3,835	3,765	3,738	4,060	3,879	3,988	4,064	4,016	4,310	4,428	4,246	3,605
Indiana.....	7,236	7,229	7,062	7,193	7,373	7,225	7,019	6,676	7,071	7,257	7,477	7,081	7,929
Kansas and Nebraska.....	2,019	1,883	1,884	1,866	2,069	2,040	2,078	1,989	1,994	2,029	1,868	2,147	1,984
Kentucky and Tennessee.....	15,154	15,050	14,245	13,993	13,152	13,306	13,072	12,939	12,359	12,068	12,156	12,981	13,732
Louisiana and Alabama.....	15,761	893	970	918	808	1,040	961	816	762	1,026	1,243	1,051	1,001
Maryland.....	1,017	1,025	1,003	954	835	1,003	977	1,081	953	1,545	852	1,730	924
Massachusetts and Rhode Island.....	1,399	1,287	1,374	1,413	1,497	1,497	1,465	1,316	1,420	1,339	1,451	1,417	1,479
Michigan.....	1,280	292	248	254	248	258	278	260	278	283	418	321	353
Mississippi.....	481	4,423	4,581	4,371	4,894	4,577	4,627	4,608	4,582	4,544	4,617	4,811	4,789
Missouri and Iowa.....	931	951	878	886	1,046	1,030	984	900	880	785	944	897	754
Montana.....	3,262	2,844	3,365	3,518	4,084	4,402	4,019	4,139	4,234	4,298	4,841	4,598	3,879
New Jersey.....	1,450	1,500	1,445	1,417	1,342	1,162	1,128	1,098	1,187	1,310	1,232	1,240	1,229
New Mexico.....	834	986	1,045	957	971	970	939	929	1,043	1,048	1,175	1,055	1,222
New York.....	6,909	7,349	7,555	8,289	8,695	9,005	9,056	8,744	9,043	8,508	8,274	8,135	8,025
Ohio.....	27,968	28,204	28,589	29,298	29,870	30,626	31,382	30,517	30,683	31,061	30,406	30,491	30,771
Oklahoma.....	6,834	6,604	6,879	7,503	7,942	7,330	7,816	6,870	7,752	7,170	7,737	7,285	7,718
Pennsylvania.....	98,675	101,282	102,706	98,093	96,342	96,574	92,847	89,885	89,209	88,504	88,353	88,818	86,969
Texas.....	440	416	419	436	432	508	506	462	508	548	283	238	225
Utah.....	991	995	1,014	936	1,009	1,034	1,107	991	1,012	970	999	1,000	1,031
West Virginia.....	8,748	8,063	7,993	7,497	7,155	6,994	6,410	5,943	5,608	5,236	5,172	5,317	5,171
Wyoming and Idaho.....													
Total gasoline-bearing crude.....	242,132	241,245	241,718	236,220	234,694	235,176	229,631	223,503	223,901	222,868	223,500	222,759	220,862
Heavy crude in California.....	7,272	6,852	6,563	6,766	6,473	6,254	6,118	6,186	6,291	6,469	6,487	6,482	6,107
Total crude petroleum in the United States.....	249,404	248,097	248,271	242,986	241,167	241,430	235,749	229,689	230,192	229,337	229,987	229,241	226,969

1 Final figures.

*Stocks of crude petroleum in the United States in 1944, by States of origin and by months*¹
[Thousands of barrels]

State	Jan. 1	Jan. 31	Feb. 29	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
ORIGIN													
Arkansas.....	2,973	2,906	2,913	2,875	2,936	2,842	2,776	2,888	2,731	2,814	2,928	3,032	3,165
California.....	29,784	28,025	26,693	25,010	23,660	23,586	22,216	21,906	22,190	22,553	22,042	20,797	20,269
Colorado.....	354	350	327	271	248	304	435	435	334	362	341	345	346
Florida.....	4	6	8	14	10	11	12	13	14	14	15	15	16
Illinois.....	13,118	13,616	14,647	14,885	14,725	14,685	14,396	14,316	14,629	14,740	14,098	13,153	13,224
Indiana.....	191	190	193	196	177	174	201	179	162	245	246	350	282
Kansas and Nebraska.....	7,547	7,552	7,908	8,168	8,021	8,764	8,507	8,462	8,230	8,307	8,253	8,355	8,165
Kentucky.....	1,270	1,187	1,060	1,238	1,239	1,274	1,179	1,140	1,084	1,096	1,113	1,252	1,283
Louisiana.....	14,662	14,879	13,947	13,331	13,696	13,544	12,807	12,675	12,044	11,936	12,327	13,249	13,528
Michigan.....	1,163	974	1,048	1,010	1,052	1,033	972	886	1,024	900	929	1,065	1,090
Mississippi.....	995	963	829	935	1,023	1,012	967	842	959	1,041	1,001	1,122	1,071
Missouri.....	940	939	854	846	1,030	1,044	873	892	831	783	904	857	725
Montana.....	7,100	7,064	6,828	6,937	6,567	6,196	6,210	6,078	6,258	6,267	6,363	6,612	6,563
New Mexico.....	212	191	196	196	182	188	195	142	199	200	207	196	173
New York.....	662	522	571	511	495	592	718	687	747	873	805	997	479
Ohio.....	31,964	31,612	31,527	31,657	32,080	31,544	31,780	31,480	31,375	30,833	30,107	30,784	31,047
Oklahoma.....	1,364	1,322	1,354	1,389	1,371	1,454	1,440	1,205	1,307	1,250	1,209	1,161	1,060
Pennsylvania.....	116,489	117,594	119,137	116,405	114,999	115,316	113,253	109,751	109,657	110,689	110,344	110,882	109,336
Texas.....	587	553	573	554	556	615	558	528	642	633	606	588	546
Texas-Virginia.....	10,504	9,681	9,482	8,564	8,564	8,297	7,800	7,225	6,744	6,231	5,093	6,094	5,919
Wyoming.....	1,329	1,186	1,646	1,000	2,070	2,518	2,284	1,749	2,138	1,966	2,085	2,318	2,451
Foreign.....	242,132	241,245	241,718	238,220	234,684	235,176	229,631	223,593	223,901	222,868	223,500	222,740	220,892
Total gasoline-bearing crude.....	7,272	6,853	6,553	6,766	6,473	6,254	6,118	6,186	6,291	6,469	6,487	6,482	6,107
Heavy crude in California.....	249,404	248,097	248,271	242,986	241,167	241,450	235,749	229,689	230,192	229,337	229,987	229,241	228,996

¹ Final figures.

Stocks of crude petroleum¹ in the United States in 1944, by location and months
[Thousands of barrels]

Classification	Jan. 1	Jan. 31	Feb. 29	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
At refineries:													
Arkansas.....	323	309	292	344	327	353	322	358	300	295	285	296	332
California and Washington.....	7,113	6,834	6,964	6,775	6,878	6,854	6,412	6,485	7,173	7,073	6,849	6,679	6,611
Georgia, Maryland, Massachusetts, Rhode Island, South Carolina, and Virginia.....	1,851	2,103	2,146	1,903	1,934	2,431	2,285	2,285	2,076	1,905	2,390	2,063	2,229

Illinois, Minnesota, and Wisconsin.....	2, 108	2, 099	2, 454	2, 444	2, 606	2, 327	2, 431	2, 647	2, 037	2, 026	2, 334	2, 673
Indiana.....	1, 523	1, 614	1, 596	1, 581	1, 662	1, 660	1, 640	1, 640	1, 760	1, 740	1, 743	1, 597
Kansas and Nebraska.....	1, 604	1, 632	1, 645	1, 708	1, 691	1, 680	1, 638	1, 433	1, 394	1, 442	1, 488	1, 839
Kentucky and Tennessee.....	752	707	749	967	841	840	930	805	805	865	1, 037	839
Louisiana, Alabama, and Mississippi.....	4, 949	4, 827	4, 710	4, 058	3, 470	3, 418	3, 307	3, 265	3, 330	3, 637	3, 499	3, 909
Michigan.....	491	420	438	617	604	621	486	488	429	523	459	509
Missouri.....	238	243	242	435	231	231	281	238	263	267	272	274
Montana and Colorado.....	2, 635	605	576	730	692	703	651	628	620	625	653	483
New Jersey.....	38	65	72	35	60	60	67	86	86	88	87	69
New York.....	869	741	686	662	642	667	657	738	867	958	756	861
Ohio.....	1, 097	1, 326	1, 241	1, 630	1, 486	1, 320	1, 499	1, 649	1, 649	1, 608	1, 362	1, 324
Oklahoma.....	1, 732	1, 835	1, 827	1, 801	2, 008	2, 100	1, 971	2, 064	2, 162	2, 142	2, 259	2, 188
Pennsylvania.....	3, 036	2, 978	3, 780	4, 280	3, 613	4, 142	3, 840	4, 249	3, 880	4, 190	3, 985	4, 369
Texas.....	16, 539	16, 143	15, 953	16, 562	15, 831	16, 127	16, 580	15, 360	14, 738	14, 933	14, 465	14, 105
West Virginia.....	32	46	61	76	81	75	50	84	79	82	119	65
Wyoming, Idaho, and Utah.....	1, 124	1, 132	1, 857	1, 439	1, 472	1, 511	1, 409	1, 444	1, 264	1, 182	1, 139	1, 159
Total at refineries.....	47, 719	47, 686	48, 911	51, 625	60, 407	60, 190	48, 895	50, 150	48, 919	50, 323	49, 039	48, 576
Pipeline and tank-farm stocks:												
Arkansas.....	2, 273	2, 231	2, 316	2, 308	2, 255	2, 290	2, 313	2, 307	2, 293	2, 343	2, 039	2, 154
California.....	10, 456	13, 130	14, 717	13, 148	13, 212	12, 235	11, 760	11, 346	11, 759	11, 546	10, 363	10, 001
Illinois and Indiana.....	4, 702	4, 722	4, 583	4, 785	4, 654	4, 423	4, 265	4, 708	4, 945	4, 193	3, 518	3, 000
Kansas and Nebraska.....	1, 207	1, 116	1, 025	1, 106	1, 339	1, 061	879	1, 049	1, 014	7, 889	5, 085	5, 080
Kentucky and Tennessee.....	9, 780	9, 673	9, 562	8, 516	9, 313	8, 611	8, 794	8, 543	8, 707	7, 889	6, 263	6, 074
Louisiana and Mississippi.....	4, 555	4, 650	4, 121	4, 648	4, 313	4, 369	4, 647	4, 372	4, 703	4, 369	4, 739	4, 780
Michigan.....	377	308	331	308	329	360	317	327	323	350	4, 539	4, 513
Missouri and Iowa.....	907	913	907	908	908	907	907	907	907	907	907	907
Montana and Colorado.....	847	847	847	847	847	847	847	847	847	847	847	847
New Jersey.....	5, 692	5, 692	5, 692	5, 692	5, 692	5, 692	5, 692	5, 692	5, 692	5, 692	5, 692	5, 692
New Mexico.....	25, 076	25, 076	25, 076	25, 076	25, 076	25, 076	25, 076	25, 076	25, 076	25, 076	25, 076	25, 076
Oklahoma.....	4, 612	4, 612	4, 612	4, 612	4, 612	4, 612	4, 612	4, 612	4, 612	4, 612	4, 612	4, 612
Pennsylvania, New York, and West Virginia.....	79, 246	81, 090	82, 254	78, 200	75, 950	78, 983	70, 305	69, 874	69, 894	69, 370	70, 093	68, 279
Texas.....	7, 689	6, 942	6, 177	5, 814	5, 625	4, 990	4, 576	4, 172	3, 920	3, 858	3, 991	3, 822
Wyoming and Utah.....	181, 422	179, 979	174, 105	169, 574	171, 467	165, 227	160, 938	160, 162	160, 216	159, 447	159, 582	158, 181
Total pipeline and tank farm.....	12, 991	13, 580	13, 204	13, 495	13, 302	13, 214	13, 670	13, 589	13, 733	13, 730	14, 138	14, 105
Producers' stock.....												
Total United States:												
1944.....	242, 132	241, 245	236, 220	234, 694	235, 176	229, 631	223, 503	223, 901	222, 948	223, 500	223, 759	220, 862
1943.....	234, 889	234, 658	242, 710	243, 469	244, 415	241, 136	239, 824	237, 620	235, 322	239, 986	243, 279	242, 132

: Final figures.

: Excludes stocks of California heavy crude.

CONSUMPTION AND DISTRIBUTION

Runs to stills.—Total crude runs to stills amounted to 1,666 million barrels in 1944, a gain of 236 million barrels (16.5 percent) compared with 1943. Foreign crude runs increased to 43 million barrels, and runs of domestic crude rose to a new record of 1,623 million barrels.

The principal changes in refinery operations, by districts, in 1944 were gains of 74 million barrels in crude runs in the Texas Gulf Coast, 63 million in the East Coast, 31 million in California, 27 million in the Louisiana Gulf, and 14 million in the Indiana-Illinois district. New records for crude runs were established in every district except the Appalachian and Arkansas-Louisiana Inland.

The major part of the increase in total crude runs resulted from a greater utilization of existing refinery capacity. The ratio of runs to the total capacity of operating refineries was about 93 percent in 1944 compared with about 85 percent in 1943.

Distribution.—The total demand for domestic crude petroleum rose from 1,501 million barrels in 1943 to another new record of 1,701 million barrels in 1944—a gain of over 200 million barrels or more than 13 percent. The increased demand was met by a gain of 172 million barrels in crude production and a withdrawal of over 23 million barrels from stocks of domestic crude oil compared with an increase of about 5 million barrels in such stocks in 1943. The supply of domestic crude petroleum was supplemented by an increase in the imports of foreign crude oil from 14 million barrels in 1943 to 45 million in 1944. Imports of refined oils decreased about 2 million barrels, and total stocks of refined oils showed a gain of almost 17 million barrels in 1944 compared with a decline of 18 million barrels in 1943.

Receipts of domestic and foreign crude petroleum at United States refineries totaled 1,436 million barrels in 1943 and 1,669 million in 1944. In 1944 receipts of foreign crude petroleum were about 45 million barrels or 2.7 percent of the total; interstate receipts of domestic crude were 634 million barrels or 38.0 percent of the total; and intra-state receipts were 989 million barrels or 59.3 percent of the total.

Refinery receipts of crude in 1944, by methods of transportation, indicated that 83.3 percent of the total was delivered by pipe lines compared with 82.1 percent in 1943; that 6.8 percent was delivered by tank car and truck compared with 10.7 percent in 1943; and that 9.9 percent was delivered by boat compared with 7.2 percent in 1943. These figures indicate an improvement in the supply of tankers that permitted larger imports of foreign crude oil and diversion of tank cars to the movement of refined products, with the relative gain in pipe-line and boat movements.

The principal changes in the market demand for crude petroleum by States of origin (computed from production and changes in crude stocks by origin) in 1944 compared with 1943 were increases of about 171 million barrels for Texas, 34 million for California, 9 million for Louisiana, 3 million for New Mexico, 2 million for Arkansas, and 2 million for Kentucky. The largest decreases in crude demand were 8 million barrels for Kansas, 5 million for Oklahoma, 3 million for Mississippi, 2 million for Michigan, and 2 million for Pennsylvania. Twelve States had a market demand exceeding 10 million barrels a year in 1944 and contributed about 98 percent of the total supply.

*Runs to stills of crude petroleum in the United States in 1944, by districts and months*¹
[Thousands of barrels]

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
East Coast:													
Domestic.....	17,548	17,320	18,302	18,157	18,105	17,483	18,747	18,194	17,313	17,706	17,148	17,830	213,943
Foreign.....	3,111	2,601	2,861	2,291	3,751	3,946	3,746	4,583	3,946	4,491	3,872	3,904	43,103
Total East Coast.....	20,659	19,921	21,163	20,448	21,856	21,429	22,493	22,777	21,259	22,287	21,020	21,734	257,046
Appalachian:													
Indiana, Illinois, Kentucky, etc.....	4,839	4,487	4,679	4,609	4,691	4,471	4,798	4,898	4,792	4,941	4,547	4,697	56,349
Oklahoma, Kansas, Missouri, etc.....	23,722	22,092	23,066	21,415	23,522	23,183	23,883	23,702	22,809	23,668	23,223	24,190	278,785
Texas Inland.....	10,802	10,086	10,787	10,359	11,184	11,064	11,495	11,517	11,396	11,567	11,172	11,677	133,106
Total Texas Gulf Coast:	6,558	5,978	6,844	6,659	6,799	6,832	7,106	7,184	7,135	7,188	7,135	7,111	82,529
Texas Gulf Coast:													
Domestic.....	31,390	30,010	34,552	33,206	34,952	35,298	35,611	35,190	34,658	34,668	34,383	35,473	409,391
Foreign.....													
Total Texas Gulf Coast.....	31,390	30,010	34,552	33,206	34,952	35,298	35,611	35,190	34,658	34,668	34,383	35,473	409,391
Louisiana Gulf Coast:													
Domestic.....	4,971	5,738	6,183	5,905	6,891	7,227	7,970	7,855	8,028	7,908	7,725	8,003	84,414
Foreign.....	8	21	14	15	5	2	2						67
Total Louisiana Gulf Coast.....	4,979	5,759	6,207	5,920	6,896	7,229	7,972	7,855	8,028	7,908	7,725	8,003	84,481
Arkansas-Louisiana Inland:													
Rocky Mountain.....	2,330	2,317	2,330	2,337	2,332	2,391	2,184	2,431	2,344	2,412	2,366	2,234	28,028
California.....	3,439	3,289	3,224	3,224	3,307	3,496	3,510	3,441	3,911	3,607	3,198	3,824	41,254
Total domestic.....	24,443	23,464	24,455	24,253	23,998	24,534	21,373	24,052	24,121	25,574	25,276	26,182	294,715
Total foreign.....	130,042	124,371	135,027	130,024	135,781	135,989	139,686	138,464	136,507	139,229	136,173	141,221	1,622,514
Total United States:													
Daily average.....	133,161	126,993	137,902	132,830	139,537	139,937	143,434	143,047	140,453	143,720	140,045	145,125	1,665,684
	4,296	4,379	4,448	4,411	4,501	4,665	4,527	4,614	4,682	4,636	4,668	4,681	4,451

¹ Subject to revision.

Demand for crude petroleum in the United States, 1941-44, by States of origin

[Thousands of barrels]

State	1941		1942		1943		1944 ¹	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Arkansas.....	27,206	74.5	26,902	73.7	27,143	74.4	29,226	79.9
California.....	232,246	636.3	250,479	686.2	288,363	790.0	322,473	881.1
Colorado.....	2,050	5.6	2,191	6.0	2,431	6.7	2,953	8.1
Illinois.....	134,327	368.0	115,417	316.2	78,396	214.8	77,307	211.2
Indiana.....	7,869	21.6	6,638	18.2	5,340	14.6	5,027	13.7
Kansas.....	84,209	230.7	98,281	269.3	105,715	289.7	98,134	268.1
Kentucky.....	4,677	12.8	4,687	12.8	7,775	21.3	9,598	26.2
Louisiana.....	116,420	319.0	116,394	318.9	121,085	331.7	130,381	356.2
Michigan.....	15,616	42.8	22,318	61.2	20,699	56.7	18,573	50.7
Mississippi.....	13,632	37.3	29,646	81.2	19,638	53.8	16,261	44.4
Montana.....	7,146	19.6	8,824	24.2	7,634	20.9	8,842	24.2
Nebraska.....	1,881	5.2	1,234	3.4	613	1.7	427	1.2
New Mexico.....	40,061	109.8	32,819	89.9	37,599	103.0	40,062	109.5
New York.....	5,294	14.5	5,364	14.7	5,138	14.1	4,726	12.9
Ohio.....	3,666	10.0	3,552	9.7	3,260	8.9	3,020	8.2
Oklahoma.....	166,357	455.8	153,413	420.3	130,384	357.2	125,533	343.0
Pennsylvania.....	16,771	45.9	18,311	50.2	16,048	44.0	14,382	39.3
Texas.....	507,283	1,389.8	461,425	1,264.2	583,113	1,597.6	754,272	2,060.9
West Virginia.....	4,006	11.0	3,843	10.5	3,591	9.8	3,101	8.5
Wyoming.....	29,737	81.5	34,401	94.3	36,690	100.5	36,933	100.9
Other States.....	63	.1	45	.1	48	.1	79	.2
Total United States....	1,420,517	3,891.8	1,396,184	3,825.2	1,500,703	4,111.5	1,701,310	4,648.4

¹ Subject to revision.

The most notable change in crude supply was the increase in the demand for Texas crude from 583 million barrels in 1943 to 754 million in 1944—a gain of 29 percent. The relative contribution of Texas rose from 38 percent of total national demand in 1943 to 44 percent in 1944—a gain due to the ability to expand production and the improvement in internal transportation resulting from the operation of the 24-inch crude line and to the 20-inch products line from Texas to Illinois and to the East Coast States. The record production of 748 million barrels was supplemented by a withdrawal of 6 million barrels from stocks of Texas origin. Deliveries to refineries in Texas rose from 344 million to 424 million in 1944, and deliveries to refineries in other States increased from 226 million barrels in 1943 to 317 million in 1944. Deliveries to the East Coast district showed a gain of 47 million barrels and to the Illinois-Indiana district of 26 million compared with 1943.

California ranks second as a source of crude supply in the United States and furnished 19 percent of the total supply in both 1943 and 1944. The demand for California crude amounted to over 322 million barrels in 1944—a gain of 34 million barrels or 12 percent. The growing demand for oil to supply war operations in the Pacific and the increasing requirements for industrial and railroad fuels in the Pacific Coast area made it essential to increase production. Arrangements were made to produce a substantial amount of crude from the naval reserves in the Elk Hills district. Tank-car shipments of West Texas crude to California were inaugurated at the end of 1944 to utilize surplus refinery capacity. The record production of 312 million barrels was supplemented by a withdrawal of almost 11 million barrels from crude stocks of California origin. The increase in crude-oil supplies resulted in only a minor change in the stocks of refined oils compared with a decrease of 23 million barrels in 1943. Intrastate deliveries of crude to refineries amounted to 294 million barrels in 1944, 23 million barrels were transferred for direct use as fuel oil, and 5 million barrels were exported.

Louisiana was the third-largest source of domestic crude oil supply in 1944, furnishing almost 8 percent of the total. Demand rose from 121 million barrels in 1943 to 130 million in 1944. Production amounted to 129 million barrels, and about 1 million barrels were withdrawn from storage. Intrastate deliveries showed a substantial gain, but deliveries to the East Coast declined by about 3 million barrels.

The demand for Oklahoma crude continued to decline. Although production rose from 123 million barrels in 1943 to almost 125 million in 1944, withdrawals from storage were less than 1 million barrels in 1944 compared with a withdrawal of 7 million barrels in 1943. Deliveries of crude to refineries in Oklahoma increased from 48 million barrels in 1943 to 52 million in 1944, while interstate deliveries declined from 85 million barrels to 77 million.

Daily average demand for domestic crude petroleum in the United States in 1944, by States of origin and by months¹
 [Thousands of barrels]

State	January	February	March	April	May	June	July	August	September	October	November	December	Year
Arkansas.....	81.2	79.3	81.6	78.0	82.8	83.1	75.7	87.8	78.2	76.8	77.1	75.6	76.9
California.....	883.1	879.6	875.4	887.7	844.4	898.1	859.8	846.3	890.7	896.3	919.7	914.3	881.1
Colorado.....	7.4	7.6	9.0	8.0	6.4	3.4	9.7	8.7	9.6	10.0	7.9	8.9	8.1
Illinois.....	202.8	184.8	208.6	216.7	214.5	218.5	208.2	200.8	205.0	231.0	239.7	203.6	211.2
Indiana.....	13.5	14.5	14.4	16.2	14.5	12.1	13.8	14.6	11.5	14.3	10.8	16.8	13.7
Kansas.....	299.0	261.8	265.7	265.7	263.9	294.0	264.1	279.8	267.9	265.5	271.5	266.9	268.1
Kentucky.....	25.1	27.3	18.5	20.5	23.0	28.5	26.5	30.4	28.6	30.6	26.4	29.4	28.2
Louisiana.....	338.5	387.6	373.1	344.4	360.6	378.8	340.3	355.8	378.0	345.2	323.8	340.7	359.2
Michigan.....	58.4	51.8	52.7	50.0	52.3	52.3	49.9	46.6	52.9	48.1	47.8	46.2	50.7
Mississippi.....	44.3	48.3	37.5	38.7	40.5	44.7	47.7	40.8	44.7	48.9	46.3	51.6	44.4
Montana.....	24.0	27.1	24.2	17.4	23.4	26.3	21.2	26.1	26.1	19.1	26.3	26.4	24.2
Nebraska.....	1.7	1.1	1.3	1.3	.9	.8	1.4	1.4	1.1	1.0	1.0	1.0	1.2
New Mexico.....	112.8	123.4	111.1	125.6	120.6	106.0	109.5	99.6	104.6	102.5	97.3	104.3	109.5
New York.....	12.8	12.9	12.9	13.0	13.3	13.2	12.4	13.6	13.0	12.4	12.9	12.4	12.9
Ohio.....	9.5	6.3	10.4	8.4	5.5	4.1	7.1	7.6	10.5	4.0	11.6	14.1	8.2
Oklahoma.....	340.7	330.9	335.6	318.8	355.3	324.7	386.8	341.4	368.3	375.5	339.4	346.9	343.0
Pennsylvania.....	40.1	39.2	39.0	40.0	39.0	40.7	40.9	40.8	40.6	38.5	38.2	34.7	39.3
Texas.....	1,828.3	1,867.9	1,974.8	1,992.7	2,016.0	2,122.8	2,185.2	2,134.3	2,156.0	2,120.4	2,158.2	2,167.2	2,080.9
West Virginia.....	9.5	8.1	9.3	8.2	7.1	7.8	10.8	9.0	6.8	7.9	9.9	7.1	8.5
Wyoming.....	114.4	96.1	105.8	98.0	96.7	102.8	104.3	97.8	116.3	104.6	84.7	96.8	100.9
Other States ¹	1.1	.1	.1	.1	.1	.2	.2	.1	.3	.6	.1	.3	.2
Total United States.....	4,417.2	4,454.6	4,561.0	4,649.4	4,563.8	4,756.9	4,735.5	4,683.3	4,786.7	4,751.2	4,749.4	4,764.1	4,648.4

¹ Subject to revision.² Alabama, Missouri, Tennessee, and Virginia.

Demand for domestic crude petroleum in the United States, 1943-44, by States of origin and by months
 [Thousands of barrels]

State	January	February	March	April	May	June	July	August	September	October	November	December	Year
Arkansas.....	2,582	1,972	2,129	2,260	2,194	2,074	1,947	2,545	2,578	2,144	2,376	2,332	27,143
California.....	23,397	21,514	23,261	24,185	23,800	23,768	24,730	25,037	24,110	24,714	24,244	25,613	288,863
Colorado.....	238	218	180	190	188	223	203	186	231	223	218	244	2,431
Illinois.....	7,284	6,020	6,185	7,134	6,642	5,433	7,093	6,826	6,534	6,281	6,096	6,868	78,896
Indiana.....	1,466	468	480	447	413	433	483	440	473	448	410	362	5,340
Kansas.....	8,614	8,140	9,515	8,866	9,290	8,918	9,037	9,190	8,574	8,740	8,354	8,457	105,715

	518	626	448	511	665	833	800	601	942	854	654	625	7,775
Kentucky.....	9,299	9,205	9,314	9,020	9,645	10,188	10,795	11,322	10,627	10,745	10,130	10,130	121,085
Louisiana.....	1,723	1,620	1,810	1,794	1,813	1,639	1,730	1,937	1,639	1,745	1,745	1,745	12,088
Michigan.....	2,158	1,439	2,028	1,537	1,440	1,769	1,849	1,565	1,488	1,445	1,478	1,422	7,694
Mississippi.....	597	528	525	510	689	690	610	670	776	610	668	687	7,013
Montana.....	66	60	66	65	62	56	52	52	44	44	83	14	37,669
Nebraska.....	2,640	2,368	2,495	2,939	3,360	3,300	3,096	2,846	3,594	3,498	3,495	3,771	37,669
New Mexico.....	437	355	433	439	436	444	444	397	485	473	473	473	3,138
New York.....	335	196	207	285	316	265	194	318	285	287	287	287	3,260
Ohio.....	11,265	10,677	10,867	10,333	10,751	10,088	10,113	10,968	11,142	11,059	10,751	11,175	130,384
Oklahoma.....	1,430	1,264	1,844	1,361	1,385	1,269	1,272	1,119	1,215	1,261	1,172	1,172	16,048
Pennsylvania.....	40,463	37,286	41,954	43,843	46,666	48,318	50,264	54,568	58,587	58,527	54,682	56,575	583,113
Texas.....	258	315	304	283	314	314	263	308	279	273	271	271	3,591
West Virginia.....	3,073	2,440	2,757	2,922	2,729	3,234	3,043	3,100	3,640	3,435	3,217	3,197	36,690
Wyoming.....	4	4	4	4	4	4	4	4	4	4	4	4	36,148
Other States.....													
Total United States.....	117,387	106,138	116,568	119,038	122,919	123,076	128,810	134,268	131,809	134,367	131,015	135,808	1,600,708
Arkansas.....	2,517	2,300	2,528	2,370	2,569	2,492	2,348	2,721	2,345	2,379	2,312	2,345	29,226
California.....	27,376	25,507	27,137	26,631	26,176	26,944	26,645	26,733	26,091	27,794	27,592	28,345	322,473
Colorado.....	231	229	231	240	236	231	201	208	260	260	237	276	2,953
Illinois.....	6,285	5,365	6,466	6,500	6,651	6,555	6,455	6,726	6,150	7,161	7,130	6,308	77,307
Indiana.....	418	419	447	456	448	461	428	451	343	443	324	489	5,027
Iowa.....	8,340	7,692	8,272	7,971	7,870	8,579	8,188	8,675	8,037	8,229	8,144	8,274	98,134
Kansas.....	8,778	7,790	8,577	7,616	7,713	8,554	8,222	8,942	8,938	9,950	9,702	9,911	9,598
Kentucky.....	10,494	11,238	11,667	10,331	11,180	11,364	10,840	11,626	11,340	10,702	9,713	10,653	130,381
Louisiana.....	1,810	1,502	1,635	1,500	1,620	1,569	1,545	1,445	1,598	1,491	1,434	1,434	18,573
Michigan.....	1,375	1,402	1,161	1,162	1,265	1,240	1,479	1,244	1,342	1,516	1,387	1,598	16,201
Mississippi.....	745	785	749	520	724	681	656	830	753	692	700	817	8,843
Montana.....	52	82	39	39	28	22	44	43	34	32	29	33	427
Nebraska.....	3,496	3,579	3,445	3,766	3,737	3,151	3,394	3,086	3,139	3,115	2,920	3,232	40,062
New Mexico.....	398	376	399	389	413	395	385	423	391	387	384	426	4,720
New York.....	293	183	323	252	172	121	221	235	314	125	345	436	3,020
Ohio.....	10,563	9,596	10,403	9,564	11,013	9,748	10,440	10,582	11,049	11,639	10,753	10,753	126,533
Pennsylvania.....	1,244	1,137	1,201	1,201	1,209	1,265	1,287	1,265	1,217	1,192	1,075	1,075	14,382
Texas.....	56,677	54,168	61,219	59,781	62,496	63,684	67,742	66,163	64,679	66,733	64,747	67,183	764,272
West Virginia.....	293	234	289	247	221	235	334	279	206	246	206	221	3,101
Wyoming.....	3,645	2,758	3,281	2,941	2,781	3,065	3,224	3,033	3,488	3,244	2,641	3,602	36,933
Other States.....	4	4	4	5	4	7	6	5	9	19	4	8	36,979
Total United States.....	126,834	120,184	141,391	136,482	141,478	142,708	146,802	148,182	143,692	147,287	142,483	147,687	1,761,310

1 Missouri (36), Tennessee (10), and Virginia (2).

2 Subject to revision.

3 Alabama (33), Missouri (34), Tennessee (10), Virginia (2).

The demand for Kansas crude rose rapidly from 61 million barrels in 1939 to 106 million in 1943 but fell to 98 million in 1944. The decline was due primarily to the decrease in production, as stocks increased slightly in both 1943 and 1944. As deliveries of 44 million barrels to refineries in Kansas have shown virtually no change during the past 3 years, the decline has been in interstate shipments. Deliveries to refineries in Illinois and Indiana declined from 44 million barrels in 1943 to about 40 million in 1944, and the emergency shipments to the Atlantic Coast in 1942 and 1943 ceased in 1944.

The demand for Illinois crude reached a peak of 145 million barrels in 1940 and then declined rapidly to 78 million in 1943, with a further small decline to 77 million barrels in 1944. There was no change in intrastate deliveries, amounting to 26 million barrels in 1944, or in shipments of about 15 million barrels to the Appalachian district. Deliveries to the Atlantic Coast were almost eliminated in 1944.

The demand for New Mexico crude increased from 38 million barrels in 1943 to 40 million in 1944. Deliveries to refineries in Texas rose from 25 million to 28 million barrels. Delivery of 5 million barrels to Illinois refineries in 1944 was over 2 million barrels less than in 1943.

There was virtually no change in the demand for Wyoming crude, which amounted to 37 million barrels in 1944. Production declined from 34 million barrels in 1943 to 32 million in 1944, but withdrawals from stocks of Wyoming origin were 2 million barrels greater than in 1943. Intrastate deliveries to refineries rose to over 17 million barrels, but interstate deliveries to Illinois, Indiana, Kansas, and Missouri declined over 3 million barrels.

The demand for Arkansas crude rose from 27 million barrels in 1943 to 29 million in 1944 and was due primarily to a corresponding increase in production. Deliveries to refineries in Arkansas totaled 14 million barrels.

The production of crude petroleum in Michigan declined about 2 million barrels and there was a corresponding reduction in demand that amounted to less than 19 million barrels in 1944. Intrastate deliveries of 17 million barrels were the same as in 1943, but shipments to western Ohio declined from 4 million barrels in 1943 to 2 million in 1944.

The demand for crude of Mississippi origin reached a peak of 30 million barrels in 1942, declined to 20 million in 1943, and to 16 million barrels in 1944. Deliveries to East Coast States have declined rapidly, and the chief markets in 1944 were in Kentucky, Ohio, and Illinois.

The production of crude oil declined in all the Appalachian States in 1944. Production in Pennsylvania fell from almost 16 million barrels in 1943 to about 14 million in 1944. The combined demand for Pennsylvania, New York, and West Virginia crude amounted to about 25 million barrels in 1943 and 22 million in 1944. Shipments from these States to New Jersey were about 4 million barrels in 1943 and 1944, and the remainder of the crude was refined in the Appalachian district.

The production and demand for Kentucky crude increased from about 8 million barrels in 1943 to almost 10 million in 1944. About half of the total is refined within the State.

Distribution of crude petroleum in the United States in 1944, by States:

[Thousands of barrels]

State	Production	Refinery receipts of domestic crude, by origin					Other	Runs to stills	Transfers to fuel
		Illinois	Kansas	Louisiana	New Mexico	Oklahoma	Texas		
Arkansas.....	29,418							14,220	238
California.....	311,793							295,467	23,256
Colorado.....	2,944							4,064	38
Georgia, Delaware, South Carolina, and Virginia.....								1,863	629
Illinois.....	77,413	28,018	15,047	606	4,763	20,121	25,701	3,421	95,146
Indiana.....	5,118	2,129	24,581	757	92	15,355	41,119	3,242	87,202
Kansas and Nebraska.....	99,179		43,663			9,252	5,121	1,476	59,548
Kentucky and Tennessee.....	9,631	3,337				31	1,361	12,193	336
Louisiana.....								17,276	38
Gulf.....	105,193								
Inland.....	24,014								
Maryland.....				64,469			17,426	1,868	1,141
Massachusetts and Rhode Island.....				2,814			4,493	6,424	12,858
Michigan.....				3,300			9,886	1,465	17,249
Mississippi.....	18,490	1,974		1,501			17,272	364	19,861
Missouri.....	16,337					2,065	7,064	16,775	316
Montana.....	36		1,496						167
New Jersey.....	8,627					1,944	5,356	450	9,229
New Mexico.....		251				3,469	64,287	10,115	36
New York.....	39,555			4,284	3,545		639	10,240	90,173
East.....								4,161	233
West.....	4,697	4,701	908			4,420	8,627	8,545	
Ohio.....								14,127	
East.....	2,937	9,900		55		1,084	372	8,385	142
West.....		21,645	713	2,891		9,242	14,074	51,347	
Oklahoma.....	124,616		6,068			51,664	7,049	2,946	866
Pennsylvania.....								64,329	
East.....									
West.....	14,118	452		5,775	1,081	3,596	84,567	119,855	12
Texas.....				470		1,099	1,606	14,012	
Gulf.....	251,124								
Inland.....	486,998			33,613	24,217	3,990	316,260	409,391	960
Utah.....					4,559	567	77,620	82,620	2,047
West Virginia.....	3,070						283	4,860	
Wyoming.....	32,388	11		395		1,111	240	3,124	
Other.....	57							17,701	855
Total United States.....	1,677,753	70,468	92,476	121,445	38,057	129,030	741,303	1,665,684	31,757

* Subject to revision.

* Includes Washington.

* Includes Minnesota and Wisconsin.

* Includes Idaho.

Receipts of crude petroleum at refineries in the United States, 1940-44, by methods of transportation

[Millions of barrels]

Method of transportation	1940	1941	1942	1943	1944 ¹
By boat:					
Intrastate	72.1	69.1	45.2	54.4	63.2
Interstate	205.6	199.9	74.3	35.2	57.1
Foreign	42.6	50.6	12.2	13.8	44.8
Total by boat	320.3	319.6	131.7	103.4	165.1
By pipe lines:					
Intrastate	671.0	728.9	731.2	788.8	909.6
Interstate	268.9	213.1	330.5	390.1	480.8
Total by pipe lines	939.9	1,042.0	1,061.7	1,178.9	1,390.4
By tank car and truck:					
Intrastate	26.1	17.2	18.0	15.7	16.5
Interstate	12.7	31.3	116.3	138.2	96.5
Total by tank car and truck	38.8	48.5	134.3	153.9	113.0
Grand total	1,299.0	1,410.1	1,327.7	1,436.2	1,668.5

¹ Subject to revision.

PRICES AND VALUE

The most important change in the value of crude oil at the well in 1944 resulted from the stripper-well subsidy plan effective August

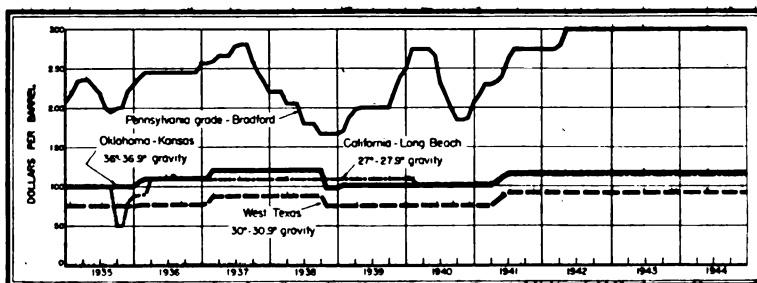


FIGURE 5.—Posted prices of selected grades of crude petroleum in the United States, 1935-44, by months.

1, 1944. Under this plan Federal payments of 35 cents a barrel were authorized for fields with average production of less than 5 barrels daily per well; of 25 cents per barrel for fields averaging 5 barrels and less than 7 barrels daily per well; and of 20 cents per barrel for fields averaging 7 barrels and less than 9 barrels daily per well. A number of other stripper pools have been granted similar subsidies because of high production costs. A payment of 75 cents per barrel for all Pennsylvania-Grade oil produced in Pennsylvania, New York, West Virginia, and Ohio also became effective at the same time.

These payments are made to the producer, and the purchaser is reimbursed by the Government. They are supplemental to posted prices. In view of this situation, the stripper-well premiums are included in the Bureau of Mines figures for average value at the well.

Complete data on such payments are not yet available by months for 1944. The amount of the subsidy payments is estimated at about \$5 million per month and, if spread over the entire national output, would raise the average value of crude oil by approximately 3 cents per barrel for a full year's production. The effect in 1944 would be roughly proportionate to the 5 months operation of the plan.

The preliminary estimate of the average value of crude oil at the well in 1944 is \$1.21 per barrel, including Federal premium payments, compared with an average value of \$1.20 in 1943. The average value per barrel in some States where a variety of different grades of oil is produced may show little change if the increased output has been in the lower-value crudes.

Value of crude petroleum at wells in the United States, 1942-48, by States¹

State	1942		1943	
	Total (thousands of dollars)	Average per barrel	Total (thousands of dollars)	Average per barrel
Arkansas.....	26,300	\$0.99	27,320	\$0.99
California.....	255,800	1.03	298,400	1.06
Colorado.....	2,440	1.11	2,620	1.13
Illinois.....	144,800	1.36	112,700	1.37
Indiana.....	9,100	1.35	7,130	1.35
Kansas.....	117,100	1.20	127,410	1.20
Kentucky.....	6,150	1.36	10,800	1.37
Louisiana:				
Gulf Coast.....	102,500	1.19	117,360	1.22
Northern.....	35,300	1.20	33,150	1.21
Total Louisiana.....	137,800	1.19	150,510	1.22
Michigan.....	30,300	1.39	26,280	1.41
Mississippi.....	26,600	.92	18,430	.98
Montana.....	8,930	1.11	9,500	1.20
Nebraska.....	1,110	.90	670	.90
New Mexico.....	31,550	1.00	38,900	1.00
New York.....	16,000	2.95	15,230	3.01
Ohio.....	6,730	1.90	6,810	2.05
Oklahoma.....	168,000	1.19	146,550	1.19
Pennsylvania.....	52,250	2.94	46,960	2.98
Texas:				
Gulf Coast.....	175,700	1.30	262,170	1.31
East Texas proper.....	144,700	1.18	162,480	1.25
West Texas.....	81,000	.99	98,230	.99
Rest of State.....	163,000	1.14	194,720	1.18
Total Texas.....	564,400	1.17	717,600	1.21
West Virginia.....	9,040	2.53	8,670	2.59
Wyoming.....	20,000	.88	38,570	.98
Other States ²	50	1.11	60	1.15
Total United States.....	1,643,470	1.19	1,809,020	1.20

¹ Figures for 1944 not yet available.

² Missouri and Tennessee, 1942; Florida, Missouri, Tennessee, and Virginia, 1943.

Posted price per barrel of petroleum at wells in the United States in 1944, by grades, with dates of change

Date	Pennsylvania Grade		Corning Grade in Buckeye Pipe Line Co. ¹	Western Kentucky ²	Illinois Basin ³	Midland, Mich. ⁴	Oklahoma-Kansas ⁵	
	Bradford and Alleghany districts ¹	In South-west Pennsylvania pipe lines ²					34°-34.9°	36°-36.9°
January 1.....	\$3.00	\$2.65	\$1.31	\$1.37	\$1.37	\$1.44	\$1.13	\$1.17
	3.00	2.65	1.31	1.37	1.37	1.44	1.13	1.17

Date	Panhandle Texas (Carson, Gray, Hutchinson, and Wheeler Counties, 35°-35.9° ⁷)	West Texas, 30°-30.9° ⁸	Lea County, N. Mex., 30°-30.9° ⁹	South Texas, Duval-Mirando, 22°-22.9° ¹⁰	East Texas ¹¹	Gulf Coast			
						Conroe, Tex. ¹	Texas 30°-30.9° ²	Texas 20°-20.9° ³	Louisiana 30°-30.9° ⁴
January 1.....	\$1.12	\$0.92	\$0.92	\$1.09	\$1.25	\$1.43	\$1.28	\$1.08	\$1.10
	1.12	.92	.92	1.09	1.25	1.43	1.28	1.08	1.10

Date	Rodessa, La., 36°-36.9° ⁵	Smackover, Ark. ⁶	Salt Creek, Wyo., 36°-36.9° ¹¹	Lance Creek, Wyo. ⁴	California ¹²			
					Kettleman, 37°-37.9°	Long Beach, 27°-27.9°	Midway-Sunset, 19°-19.9°	Santa Fe Springs, 33°-33.9°
January 1.....	\$1.12	\$0.83	\$1.12	\$1.12	\$1.29	\$1.15	\$0.98	\$1.26
January 12.....		.98						
February 12.....			1.17					
November 24.....				1.25				
	1.12	.98	1.17	1.13	1.29	1.15	.98	1.26

¹ The Tide Water Associated Oil Co.² The South Penn Oil Co.³ Sohio Corporation.⁴ The Ohio Oil Co.⁵ The Pure Oil Co.⁶ Standard Oil Co. (Indiana).⁷ Humble Oil & Refining Co.⁸ The Texas Co.⁹ Standard Oil Co. of Louisiana.¹⁰ Arkansas Fuel Oil Co.¹¹ Stanolind Oil & Gas Co.¹² Standard Oil Co. of California.

REFINED PRODUCTS

GENERAL REVIEW

The most significant changes in the demand for refined products in 1944 were the expansion in the demand for aviation gasoline and the increase in fuel-oil consumption for naval and shipping uses. The civilian consumption of motor fuel was reduced to essential levels by progressive rationing in 1942 and 1943. The principal reduction in the consumption of oil for heating purposes was attained in 1943, although a small further decline is indicated in 1944. The major increase in the consumption of fuel oil by railroads took place in 1942 and 1943 and showed no material increase in 1944.

New records were established in virtually every branch of the refining industry in 1944, with a major increase in the supply of crude oil due to a gain of 172 million barrels in domestic production, an increase of 31 million barrels in crude imports, and a withdrawal of 22 million barrels from crude stocks.

Crude runs to stills rose from 1,430 million barrels in 1943 to 1,666 million in 1944—a gain of 236 million barrels. On a daily average basis, these runs amounted to 3,917,000 barrels daily in 1943 and 4,551,000 barrels daily in 1944—a gain of over 16 percent.

Runs to stills and production at refineries in the United States of the various refined products, 1940-44

[Thousands of barrels, except as otherwise indicated]

Product	1940	1941	1942	1943	1944 ¹
Input:					
Crude petroleum:					
Domestic.....	1,252,364	1,358,246	1,319,507	1,417,559	1,622,514
Foreign.....	41,798	50,946	14,596	12,179	43,170
Total crude petroleum.....	1,294,162	1,409,192	1,334,103	1,429,738	1,665,684
Natural gasoline.....	39,547	47,825	56,595	61,198	67,207
Total input.....	1,333,709	1,457,017	1,390,698	1,490,936	1,732,891
Output:					
Gasoline.....	597,375	671,110	586,971	592,425	722,718
Kerosine.....	73,882	72,586	67,474	72,270	78,344
Distillate fuel oil.....	183,304	189,177	196,714	211,516	239,152
Residual fuel oil.....	316,221	342,367	358,901	417,306	461,455
Lubricating oil.....	36,765	39,539	38,626	38,679	41,106
Wax.....	1,833	2,393	2,502	2,697	2,883
Coke.....	7,633	8,244	6,692	6,942	9,017
Asphalt.....	29,406	36,067	34,631	37,162	38,479
Still gas.....	75,950	83,354	78,924	86,755	102,239
Wax..... thousands of pounds..	513,240	670,040	700,560	755,160	807,240
Coke..... thousands of short tons..	1,526.6	1,648.8	1,338.4	1,388.4	1,803.4
Asphalt..... do.....	5,346.7	6,557.6	6,296.5	6,756.7	6,996.1
Still gas..... millions of cubic feet..	273,420	300,074	284,126	312,318	368,061
Road oil.....	7,771	9,149	8,039	2,295	1,556
Other finished products.....	3,202	6,266	8,117	9,660	18,436
Crude gasoline (net).....	902	1,219	1,669	1,009	1,745
Other unfinished oils (net).....	3,848	3,204	3,353	2,597	2,584
Shortage.....	3,313	1,250	4,791	9,623	13,177
Total output.....	1,333,709	1,457,017	1,390,698	1,490,936	1,732,891

¹ Subject to revision.

² Negative quantity; represents net excess of unfinished oils rerun over unfinished oils produced.

³ Negative quantity (overage).

Comparative analyses of statistics for the major refined products in the United States, 1940-44

[Thousands of barrels, except as otherwise indicated]

	1940	1941	1942	1943	1944 ¹
Motor fuel:					
Production.....	616,695	701,294	608,900	608,180	743,484
Imports.....	97	335	115	5,736	3,148
Exports.....	25,377	27,083	35,097	51,577	100,639
Stocks, end of period.....	83,647	{ 90,688 }	75,404	{ 69,505 }	77,874
Domestic demand.....	589,490	667,505	589,110	568,238	636,524
Kerosine:					
Production.....	73,882	72,586	67,474	72,270	78,344
Imports.....	204	191	418	375	147
Exports.....	3,374	3,221	2,576	4,752	4,765
Stocks, end of period.....	9,512	{ 9,599 }	10,064	9,359	11,150
Domestic demand.....	68,776	69,469	69,767	68,598	71,935

See footnotes at end of table.

*Comparative analyses of statistics for the major refined products in the United States,
1940-44—Continued*

[Thousands of barrels, except as otherwise indicated]

	1940	1941	1942	1943	1944 ¹
Distillate fuel oil:					
Production.....	183,304	189,177	196,714	211,516	239,152
Transfers.....	2,576	2,513	2,496	3,070	3,242
Imports.....	3,333	5,074	3,636	15,269	7,096
Exports.....	19,140	16,925	21,575	24,957	43,345
Stocks, end of period.....	{ 42,940	{ 49,926	{ 44,940	{ 41,728	{ 38,333
	{ 42,911	{ 49,330			
Domestic demand.....	160,851	172,824	185,661	206,110	209,540
Residual fuel oil:					
Production.....	316,221	342,367	358,901	417,306	461,455
Transfers.....	7,699	12,969	19,283	24,087	28,515
Imports.....	29,366	37,369	18,432	27,210	36,553
Exports.....	16,109	14,114	12,095	14,894	13,827
Stocks, end of period.....	{ 89,304	{ 83,195	{ 61,783	{ 48,484	{ 50,383
	{ 88,026	{ 82,959			
Domestic demand.....	340,163	383,422	405,697	467,008	510,797
Lubricating oil:					
Production.....	36,765	39,539	38,626	38,679	41,106
Imports.....	11				
Exports.....	10,461	9,924	8,272	8,863	8,889
Stocks, end of period.....	8,767	8,127	9,424	7,781	7,815
Domestic demand.....	24,690	30,255	29,087	31,439	32,183
Wax (thousands of pounds):					
Production.....	513,240	670,040	700,560	755,160	807,240
Imports.....	83,102	16,542	9,749	109	
Exports.....	189,794	213,075	153,519	172,799	161,877
Stocks, end of period.....	123,272	74,814	85,400	82,040	93,800
Domestic demand.....	356,924	523,965	546,204	583,830	633,603
Coke (thousands of short tons):					
Production.....	1,526.6	1,648.8	1,338.4	1,388.4	1,803.4
Exports.....	298.7	279.1	325.3	314.0	208.9
Stocks, end of period.....	487.0	225.0	253.8	258.2	187.2
Domestic demand.....	1,406.9	1,628.7	1,007.3	1,050.0	1,665.5
Asphalt (thousands of short tons):					
Production.....	5,346.7	6,557.6	6,296.5	6,756.7	6,996.1
Imports.....	137.7	158.3	121.2	113.0	90.7
Exports.....	206.4	274.1	113.8	98.9	131.1
Stocks, end of period.....	614.0	604.0	411.0	563.3	626.2
Domestic demand.....	5,124.0	6,451.8	6,496.9	6,618.5	6,892.8
Road oil:					
Production.....	7,771	9,149	8,030	2,205	1,556
Stocks, end of period.....	624	793	348	193	189
Domestic demand.....	7,849	8,980	8,484	2,450	1,560
Other finished products:					
Production.....	3,202	6,266	8,117	9,660	18,436
Transfers of L. P. G. from natural gaso-					
line.....	(⁴)	6,281	7,195	11,589	12,652
Exports.....	708	660	657	841	864
Stocks, end of period.....	359	{ 384	{ 597	{ 734	{ 965
		{ 489			
Domestic demand.....	2,411	11,862	14,547	20,271	29,993
Unfinished gasoline:					
Rerun (net).....	1,902	1,219	1,669	1,009	1,745
Stocks.....	6,466	7,685	9,354	{ 10,363	{ 13,208
				{ 11,463	
Other unfinished oils:					
Rerun (net).....	3,848	3,204	3,353	1,597	1,584
Transfers of cycle products.....	(⁴)	(⁴)	(⁴)	1,574	1,821
Imports.....	7,024	2,637	366	366	9
Stocks.....	40,091	39,524	26,537	41,074	45,488
Shortage.....	3,313	-1,250	4,791	9,623	13,177

¹ Subject to revision.² New basis—to compare with following year.³ Negative quantity; represents net excess of unfinished rerun over unfinished produced.⁴ Not available.

New records were set in the total demand for all refined products in 1944 except for petroleum coke and road oil. The total demand for motor fuel amounted to 737 million barrels, for residual fuel oil to 525 million barrels, and for distillate fuel oil to 253 million barrels. These three products combined represented 81 percent of the total demand for all oils.

Exports of refined products totaled 175 million barrels in 1944 compared with 107 million in 1943. Exports of motor fuel rose from 52 million barrels in 1943 to 101 million in 1944; exports of distillate fuel oil increased from 25 million barrels in 1943 to 43 million in 1944; and exports of residual fuel oil declined from 15 million barrels in 1943 to 14 million in 1944. These three products represented 90 percent of the total exports of refined products in 1944.

The domestic demand for all oils, including military consumption at home and all shipments to our armed forces abroad, amounted to 1,670 million barrels in 1944 compared with 1,521 million in 1943. The domestic demand for motor fuel rose from 568 million barrels in 1943 to 637 million in 1944 but was 31 million barrels less than the peak demand in 1941; the domestic demand for residual fuel oil increased from 467 million barrels in 1943 to 511 million in 1944; and the domestic demand for distillate fuel oil showed a small gain from 208 million barrels in 1943 to 210 million in 1944. The three products together represented 81 percent of the total domestic demand.

Total imports of refined products were reduced to about 24 million barrels in 1942, owing to a scarcity of tankers and to enemy submarine attacks, but increased to 50 million barrels in 1943 and showed a small decline to 48 million barrels in 1944. Residual fuel oil has been the principal refined import and has been used primarily for bunkering vessels engaged in the foreign trade. Imports of residual fuel oil amounted to 37 million barrels in 1941, fell to 18 million in 1942, and rose to 27 million in 1943 and 37 million in 1944. Imports of distillate fuel oil rank second in importance and rose from 4 million barrels in 1942 to 15 million in 1943 and declined to 7 million barrels in 1944.

Changes in the amount of crude oil refined and in the demand for the major products have been reflected in the variations in refinery yields. The yield of gasoline declined to a low of 37.1 percent in 1943, when civilian consumption was being progressively reduced and before the full effect of war demands was felt. The expansion in production to meet military requirements in 1944 resulted from the large increase in crude runs, combined with the higher yield of 39.4 percent. The yield of residual fuel oil rose from 24.3 percent in 1941 to a peak of 29.2 percent in 1943 and declined to 27.7 percent in 1944. The yield of distillate fuel oil was 13.4 percent in 1941, 14.7 percent in 1942, 14.8 percent in 1943, and 14.4 percent in 1944. The higher relative yields of fuel oils reflected the expansion in naval and transportation requirements.

The completion of most of the new major pipe lines during 1943 or early in 1944 resulted in better distribution of crude oil to refineries and of products for internal consumption. As pipe-line deliveries to the East Coast increased progressively, tank cars were released for essential movements in other districts.

Readjustments in transportation and changes in the relative demand for products have resulted in substantial changes in the stocks of refined products. Total stocks of refined oils have declined

from 294 million barrels at the end of 1941 to 246 million barrels at the end of 1944. The reduction of such stocks by 47 million barrels in 1942 was due primarily to heavy withdrawals to supply demand in the East Coast district. The total reduction of 18 million barrels in 1943 represented a decline of 23 million barrels in California and a gain of 5 million in districts east of California. The increase of almost 17 million barrels in total refined stocks in 1944 occurred in areas east of California. The major change in refined stocks since the end of 1941 has been the cumulative decline of 32 million barrels in California and has been primarily a liquidation of stocks of residual fuel oil. In view of the growing demand for refined products and the readjustments in transportation and distribution, stocks of refined oils have generally been reduced to essential minimums. The stock figures used represent products in the custody of the oil companies at refineries and bulk terminals but do not include stocks in the custody of our armed forces either at home or abroad.

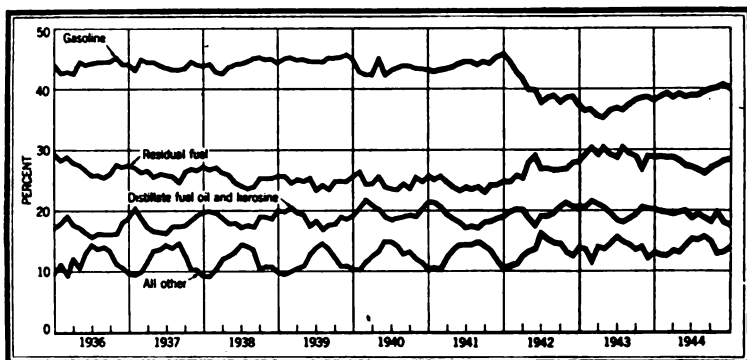


FIGURE 6.—Yields of principal products from crude oil run to stills in the United States, 1936-44, by months.

Summary of percentage yields of refined products in the United States, 1936-44

[Computed on total crude runs to stills]

Product	1936	1937	1938	1939	1940	1941	1942	1943	1944 ¹
Finished products:									
Gasoline:									
Cracked.....	22.4	22.6	23.2	23.9	22.7	24.4	22.3	22.0	23.2
Straight run.....	21.7	21.3	21.1	21.1	20.4	19.8	17.5	15.1	16.2
Total gasoline.....	44.1	43.9	44.3	45.0	43.1	44.2	39.8	37.1	39.4
Kerosene.....	5.2	5.5	5.5	5.5	5.7	5.2	5.1	5.0	4.7
Distillate fuel oil.....	11.8	12.4	13.0	13.1	14.2	13.4	14.7	14.8	14.4
Residual fuel oil.....	27.0	26.4	25.3	24.7	24.4	24.3	26.9	29.2	27.7
Lubricating oil.....	2.9	3.0	2.6	2.8	2.8	2.8	2.9	2.7	2.5
Wax.....	.2	.2	.1	.1	.1	.2	.2	.2	.2
Coke.....	.6	.6	.7	.7	.6	.6	.5	.5	.5
Asphalt.....	2.0	1.9	2.1	2.2	2.3	2.6	2.6	2.6	2.3
Road oil.....	.7	.7	.6	.6	.6	.6	.6	.2	.1
Still gas.....	5.3	5.4	5.7	5.5	5.5	5.9	5.9	6.1	6.1
Other.....	.2	.2	.2	.2	.3	.4	.6	.7	1.1
Unfinished products:									
Gasoline.....	(²)	(²)	.1	(²)	.1	.1	.1	(²)	.1
Other.....	1.8	1.7	1.4	1.9	1.3	1.2	1.3	.2	.1
Shortage.....	.8	.5	.4	.5	.6	1.1	.4	.7	.8
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

¹ Subject to revision.

² Less than 0.1 percent.

³ Negative percentage; represents excess percentage rerun over percentage produced.

Stocks of refined products in the United States, 1943-44, by months
[Thousands of barrels, except as otherwise indicated]

Product	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
1943												
Gasoline.....	78,475	82,867	84,077	78,653	73,137	67,345	62,791	60,664	59,186	59,100	59,854	59,964
Kerosine.....	7,222	6,942	4,868	5,326	6,486	8,237	9,195	10,285	10,910	11,299	10,487	9,359
Distillate fuel oil.....	39,014	35,298	31,135	30,674	30,665	32,467	34,331	36,931	39,081	44,857	44,806	41,728
Residual fuel oil.....	60,808	59,657	57,280	57,381	57,757	55,879	57,107	56,537	57,977	54,952	53,046	48,428
Lubricating oil.....	9,725	9,715	9,689	9,474	9,155	8,665	8,412	8,170	7,831	7,712	7,770	7,781
Wax.....	300	291	298	301	306	291	274	263	277	291	290	293
Coke.....	1,366	1,352	1,471	1,550	1,574	1,623	1,668	1,775	1,774	1,774	1,625	1,291
Asphalt.....	2,749	3,040	3,694	3,872	4,101	3,934	3,530	3,091	2,581	2,450	2,555	3,098
Wax.....	84,000	81,480	83,440	84,280	85,080	81,480	76,720	73,640	77,560	81,480	81,200	82,040
thousands of pounds.....	273.2	276.4	294.2	310.0	314.8	324.9	339.6	355.0	367.0	354.8	325.0	258.2
Asphalt.....	498.5	552.7	671.7	704.0	745.6	713.3	641.8	562.0	469.3	445.5	464.5	563.3
Road oil.....	396	459	359	421	386	352	340	237	182	151	165	193
Other finished products.....	675	704	701	739	792	770	731	645	583	594	778	734
Unfinished gasoline.....	10,202	9,981	10,037	10,923	10,752	10,285	10,353	10,395	10,033	9,945	9,697	10,363
Other unfinished oils.....	36,797	35,728	36,166	35,127	35,553	38,364	39,122	39,844	40,428	40,870	40,353	41,074
Total.....	247,729	245,120	239,775	234,441	230,962	228,242	227,872	229,058	231,454	234,065	231,426	229,362
1944												
Gasoline.....	69,390	72,909	75,275	76,638	74,519	70,246	68,921	66,542	64,914	65,886	68,107	73,622
Kerosine.....	8,257	7,259	6,567	6,722	8,117	9,825	11,799	13,339	14,648	14,454	13,771	11,150
Distillate fuel oil.....	36,890	33,561	29,926	30,152	32,484	35,242	38,335	40,712	43,087	47,352	45,584	38,333
Residual fuel oil.....	46,270	45,070	45,427	44,137	44,682	46,649	50,589	53,506	57,849	57,420	55,643	50,383
Lubricating oil.....	8,006	7,942	8,011	8,068	7,771	7,590	7,426	7,169	7,364	7,452	7,562	7,815
Wax.....	288	302	302	335	335	327	335	343	339	335	339	335
Coke.....	897	828	864	832	707	656	648	579	580	686	808	936
Asphalt.....	3,472	3,948	4,374	4,687	4,892	4,645	4,046	3,245	2,723	2,562	2,939	3,444
Wax.....	80,640	80,080	84,560	94,080	93,800	91,560	93,800	96,040	94,920	96,880	94,920	93,800
thousands of pounds.....	179.4	165.6	172.8	166.4	141.4	127.2	129.6	115.8	116.0	137.2	161.6	187.2
Asphalt.....	631.3	717.9	795.3	852.2	889.5	844.6	735.6	590.0	495.1	465.8	534.4	626.2
Road oil.....	230	237	331	378	417	304	286	242	201	199	170	189
Other finished products.....	772	749	785	818	847	839	880	880	948	1,137	952	965
Unfinished gasoline.....	11,919	11,843	11,972	11,735	12,193	11,738	11,581	11,924	12,072	12,388	12,467	13,208
Other unfinished oils.....	40,733	40,863	41,300	42,175	42,562	44,726	45,911	46,909	47,089	45,942	45,222	45,488
Total.....	227,124	225,495	225,134	226,478	229,526	232,767	240,737	245,390	253,014	255,824	253,564	245,868

¹ New basis—for comparison with 1944: Gasoline, 63,864; unfinished gasoline, 11,463.

² Conversion factors: 280 pounds of wax to the barrel; 5.0 barrels of coke to the short ton; 5.5 barrels of asphalt to the short ton.

³ Subject to revision.

Russ to stills and production at refineries in the United States of the various refined products, 1943-44, by months
 [Thousands of barrels, except as otherwise indicated]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Input:													
Crude petroleum.....	111,606 4,317	101,935 4,326	112,013 4,907	111,945 4,896	115,006 5,197	116,984 5,089	120,689 5,161	126,908 5,493	126,088 5,613	129,036 5,564	128,473 5,166	132,056 5,379	1,429,738 61,198
Natural gasoline.....													
Total input.....	115,923	106,261	116,920	116,931	120,202	121,073	125,850	132,401	131,701	134,600	131,639	137,435	1,490,936
Output:													
Gasoline.....	45,125	41,099	45,001	44,540	47,011	47,915	49,521	52,811	53,647	55,386	54,051	55,718	592,425
Kerosene.....	5,602	5,852	6,326	6,299	6,511	6,060	5,769	5,394	5,817	5,977	6,138	6,525	72,270
Distillate fuel oil.....	17,306	16,240	17,288	16,090	16,075	15,261	16,073	18,210	18,523	20,549	19,370	19,931	211,516
Residual fuel oil.....	32,544	30,799	32,700	34,095	33,732	33,510	36,624	37,418	36,619	34,663	36,640	37,962	417,306
Lubricating oil.....	2,935	2,780	3,184	3,107	3,281	3,162	3,257	3,296	3,236	3,635	3,580	3,217	38,679
Wax.....	206	195	233	239	228	216	214	219	222	240	245	240	2,607
Coke.....	565	467	490	511	525	576	565	608	669	656	682	628	6,942
Asphalt.....	2,398	2,148	2,657	2,870	3,207	3,516	3,707	3,820	3,644	3,588	3,047	2,560	37,162
Still gas.....	6,602	6,244	6,737	7,155	7,357	7,499	7,582	7,547	7,459	7,633	7,472	7,528	86,755
Wax..... thousands of pounds.....	57,680	54,600	65,240	66,920	63,840	60,480	59,920	61,329	62,160	67,200	68,600	67,200	756,160
Coke..... thousands of short tons.....	113.0	93.4	98.0	102.2	105.0	115.2	113.0	121.6	133.8	131.2	136.4	125.6	1,388.4
Asphalt.....	436.0	390.5	483.1	521.8	583.1	639.3	674.0	694.5	662.5	632.4	554.0	465.5	6,756.7
Still gas..... millions of cubic feet.....	23,767	22,478	24,254	25,758	26,485	26,782	27,295	27,169	26,852	27,479	26,890	27,101	312,318
Road oil.....	224	173	83	186	152	228	282	221	247	238	155	106	2,295
Other finished products.....	806	707	738	692	662	574	717	769	848	1,089	1,030	1,028	9,690
Unfinished gasoline (net).....	848	721	56	886	173	465	73	37	362	288	248	666	1,009
Other unfinished oils (net).....	152	329	329	184	581	2,374	650	608	353	278	933	562	2,597
Shortage.....	610	361	1,098	845	1,053	707	816	1,443	788	756	392	764	9,623
Total output.....	115,923	106,261	116,920	116,931	120,202	121,073	125,850	132,401	131,701	134,600	131,639	137,435	1,490,936

1944¹

Input:		133,161	126,993	137,902	132,330	139,937	143,434	143,047	140,453	143,720	140,045	145,125	1,665,684
Crude petroleum.....		5,382	4,624	5,377	5,012	5,429	6,165	6,084	5,799	6,020	6,109	6,098	67,207
Natural gasoline.....													
Total input.....		138,543	131,617	143,279	137,342	145,366	149,599	149,131	146,262	149,740	146,154	151,133	1,732,891
Output:													
Gasoline.....		56,957	54,369	58,430	56,089	59,060	61,975	62,508	61,909	63,631	63,183	64,109	722,718
Kerosine.....		7,071	6,413	6,960	6,489	6,710	6,277	6,358	6,339	6,515	6,505	6,461	78,344
Distillate fuel oil.....		19,344	18,454	19,863	19,604	21,215	21,316	20,593	19,110	21,697	18,870	19,058	236,152
Residual fuel oil.....		38,519	36,493	39,738	37,281	38,026	38,392	37,291	37,903	39,322	39,370	41,278	461,455
Lubricating oil.....		3,379	3,158	3,488	3,273	3,453	3,364	3,356	3,458	3,672	3,587	3,581	41,106
Wax ¹		254	235	285	273	234	216	227	222	241	227	240	2,883
Coke ¹		581	688	718	685	724	789	791	777	906	819	892	9,017
Asphalt ¹		2,326	2,190	2,505	2,505	3,294	3,914	4,401	4,127	3,727	3,045	2,646	38,479
Still gas ¹		7,799	7,521	8,135	7,976	8,713	9,204	9,178	8,685	8,864	8,558	8,838	102,239
Wax..... thousands of pounds		71,120	65,800	79,800	76,440	65,520	63,560	64,120	62,160	67,480	63,560	67,200	897,240
Coke..... thousands of short tons		116.2	137.6	143.6	137.0	144.8	157.8	158.2	155.4	181.2	163.8	172.4	1,893.4
Asphalt..... do.		422.9	398.2	455.4	455.5	568.9	711.6	800.2	750.4	677.6	553.6	481.1	6,996.1
Still gas..... millions of cubic feet		28,076	27,076	29,286	28,714	31,367	33,134	33,041	31,266	31,910	30,809	31,817	393,061
Road oil.....		109	61	122	84	174	292	294	153	160	76	113	1,566
Other finished products.....		1,357	1,285	1,600	1,346	1,478	1,510	1,579	1,363	1,703	1,786	1,967	18,436
Unfinished gasoline (net).....		456	176	129	237	458	157	343	148	316	79	741	1,745
Other unfinished oils (net).....		517	20	275	719	1,994	1,019	822	648	1,881	890	1,217	2,984
Shortage.....		908	846	1,031	655	1,264	1,627	1,478	1,380	1,867	899	1,092	13,177
Total output.....		138,543	131,617	143,279	137,342	145,366	149,599	149,131	146,262	149,740	146,154	151,133	1,732,891

¹ Conversion factors: 280 pounds of wax to the barrel; 5.0 barrels of coke to the short ton; 5.5 barrels of asphalt to the short ton; 3.6 cubic feet of still gas to the barrel.² Negative quantity; represents net excess return over production.³ Subject to revision.

Runs to stills and production at refineries in the United States of the various refined products, 1943-44, by districts
 (Thousands of barrels, except as otherwise indicated)

	1943										
	East Coast	Appalachian	Indiana, Illinois, Kentucky, etc.	Oklahoma, Kansas, and Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas-Louisiana Inland	Rocky Mountain	California	United States
Input:											
Crude petroleum.....	194,219	54,900	265,234	124,167	72,993	334,999	57,137	27,116	35,105	263,868	1,420,738
Natural gasoline.....	732	430	7,500	5,169	8,589	18,940	4,089	1,358	696	13,725	61,108
Total input.....	194,951	55,330	272,734	129,336	81,582	353,939	61,226	28,474	35,771	277,593	1,490,936
Output:											
Gasoline.....	68,436	22,170	126,142	60,316	40,584	133,622	22,392	10,496	16,484	91,783	592,425
Kerosine.....	7,561	3,697	14,370	8,470	3,310	22,060	6,303	2,304	794	3,401	72,270
Distillate fuel oil.....	38,077	6,460	34,631	17,099	4,701	64,506	9,477	4,017	3,667	28,881	211,516
Residual fuel oil.....	56,004	10,274	59,621	24,969	22,742	86,549	12,768	7,294	10,229	126,856	417,306
Lubricating oil.....	7,205	5,652	4,689	4,451	244	9,745	1,945	1,153	251	3,344	38,679
Wax.....	881	361	231	281	11	511	334	---	75	12	2,697
Coke.....	13	111	4,250	591	459	896	289	---	189	144	6,942
Asphalt.....	5,570	1,787	7,837	3,851	2,258	2,396	2,656	1,961	1,059	7,787	37,162
Still gas.....	12,347	2,847	16,071	6,683	3,911	26,732	4,951	1,189	1,506	10,518	86,755
Wax..... thousands of pounds	246,680	101,080	64,680	78,080	3,080	143,080	93,520	---	21,000	3,360	755,160
Coke..... thousands of short tons	2.6	22.2	850.0	118.2	91.8	179.2	57.8	---	37.8	28.8	1,388.4
Asphalt..... do.	1,012.8	324.8	1,425.0	700.1	410.5	435.6	483.0	356.5	192.6	1,415.8	6,756.7
Still gas..... millions of cubic feet	44,449	10,249	57,855	24,059	14,080	96,235	17,824	4,280	5,422	37,865	312,318
Road oil.....	12	---	41	51	---	44	1	21	807	1,406	2,295
Other finished products.....	2,746	560	1,403	355	300	1,404	888	389	99	1,426	9,660
Unfinished gasoline (net).....	2.6	127	1,124	209	469	71	150	---	46	67	1,009
Other unfinished oils (net).....	4,631	96	1,813	2,180	519	6,589	2,115	262	86	418	2,597
Shortage.....	636	1,188	1,759	2,190	2,074	3,188	117	388	479	2,386	9,623
Total output.....	194,951	55,330	272,734	129,336	81,582	353,939	61,226	28,474	35,771	277,593	1,490,936

1944 *											
Input:		287,046	56,349	278,785	133,106	82,629	400,301	84,481	29,028	41,254	294,715
Crude petroleum		2,073	410	8,911	4,850	8,272	20,241	4,580	1,708	1,140	14,944
Natural gasoline											
Total input		289,119	56,759	287,696	137,956	90,801	429,632	89,070	29,796	42,403	309,659
Output:											
Gasoline		90,371	24,163	142,276	68,280	46,519	174,239	34,324	10,696	19,984	109,867
Kerosene		9,458	3,894	13,665	7,707	4,516	22,330	10,530	2,512	8,850	27,713
Distillate fuel oil		46,763	6,313	34,544	19,281	5,303	73,935	15,572	3,726	4,333	29,382
Residual fuel oil		79,964	9,194	66,890	23,984	23,792	97,683	16,322	6,447	11,233	135,946
Lubricating oil		8,227	6,278	4,526	4,627	208	10,614	2,157	1,438	266	3,765
Wax		1,024	3,668	4,222	303	9	10,461	356	88	54	2,883
Coke		11	124	5,552	689	588	766	603	234	1,751	380
Asphalt		7,633	1,826	7,806	3,432	1,686	2,046	1,688	2,216	1,751	8,385
Still gas		14,028	3,422	18,415	7,038	4,233	31,935	8,184	1,291	1,905	11,788
Wax		286,720	102,480	62,160	84,840	2,520	129,080	99,680	15,120	24,640	807,240
Coke		2,222	24,828	1,110,428	137,828	117,628	153,228	138,628	46,828	72,028	1,803,428
Asphalt		1,387,720	333,720	1,419,428	634,428	306,428	372,028	306,928	402,928	318,428	1,524,628
Still gas		50,501	12,319	66,294	25,337	15,239	114,966	29,402	4,648	6,858	42,437
Road oil		95		32	45				19	569	793
Other finished products		3,831	978	1,481	592	999	5,995	2,300	784	110	1,396
Unfinished gasoline (net)		3,619	365	274	1,629	1,629	714	891	20	66	417
Other unfinished oils (net)		3,128	62	860	50	1,435	9,470	3,533	392	147	680
Shortage		1,451	1,194	968	2,154	1,854	870	1,424	265	774	4,103
Total output		289,119	56,759	287,696	137,956	90,801	429,632	89,070	29,796	42,403	309,659

1 Conversion factors: 280 pounds of wax to the barrel; 5.0 barrels of coke to the short ton; 5.5 barrels of asphalt to the short ton; 3.6 cubic feet of still gas to the barrel.

2 Negative quantity; represents net excess return over production.

3 Negative quantity (coverage).

4 Subject to revision.

There were some reductions in the representative prices of refined products in 1944. The price of Regular-Grade gasoline at Oklahoma refineries was 6.00 cents per gallon for the first 7 months of the year but declined to 5.90 cents in August and to 5.875 cents per gallon for the remainder of the year. The tank-wagon price of kerosine at Chicago remained constant in 1944 at 10.60 cents per gallon. The price of bright stock at Oklahoma refineries, at 22.75 cents per gallon, showed no change during the year. The price of Bunker "C" fuel oil at New York was \$1.86 per barrel for the first 7 months of 1944 and dropped to \$1.77 per barrel for the last five months of the year.

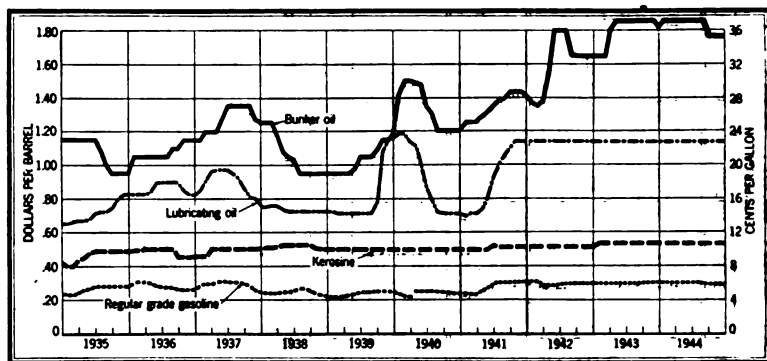


FIGURE 7.—Prices of Bunker "C" oil at New York, bright stock at Oklahoma refineries, tank-wagon price of kerosine at Chicago, and Regular-Grade gasoline at refineries in Oklahoma, 1935-44, by months.

REFINING

The data from the annual survey of refinery capacity, as of January 1, 1944, show a total capacity for crude oil at completed refineries of 5,093,023 barrels. The total capacity in operation amounted to 4,709,382 barrels, and the total shut-down capacity was 383,641 barrels. The shut-down capacity included 184,534 barrels representing shut-down units at operating refineries and 199,107 barrels at plants that were completely shut down. In addition to the completed capacity, new capacity aggregating 116,070 barrels was under construction at existing plants.

The approximate distribution of the capacity at completely shut-down refineries, by principal States, was: 57,000 barrels in California, 35,000 barrels in Louisiana (representing recently built capacity about to be put in operation), 33,000 barrels in New Jersey, 21,000 barrels in Texas, 13,000 barrels in New York, 11,000 barrels in Oklahoma, and 7,000 barrels in Montana.

Summary of refinery capacity in the United States, January 1, 1940-44

Year	Number of refineries				Capacity (barrels per day)			
	Operating	Shut down	Building	Total	Operating	Shut down	Building	Total
1940.....	461	86	10	557	4,196,604	431,962	92,567	4,721,213
1941.....	420	136	6	562	4,180,588	538,381	141,225	4,860,194
1942.....	430	92	1	523	4,496,848	460,756	48,400	4,999,999
1943.....	386	86	1	472	4,409,013	492,908	104,100	4,997,111
1944.....	384	68	—	452	4,709,382	383,641	116,070	5,209,093

¹ Subject to revision.

The total crude capacity at completed refineries has risen from 4,719,000 barrels as of January 1, 1941, to 5,093,000 barrels as of January 1, 1944. During this period the total capacity at operating plants rose from 4,181,000 barrels to 4,709,000, and the total capacity at shut-down plants declined from 538,000 barrels to 384,000. Although complete data, as of January 1, 1945, are not available, the estimated crude capacity at completed refineries would amount to about 5,200,000 barrels, with about 5,030,000 barrels at operating plants.

The most important change in the greater utilization of refinery capacity during the war has been the increase in the operating ratio at active plants, although a substantial number of shut-down plants have been opened, and several large new refineries have been completed.

The operating ratio, as published in monthly reports of the Bureau of Mines, represents the percentage obtained by dividing the average daily crude run for the month by the total capacity located at operating refineries. The 12-month average of these ratios showed an annual operating ratio of 82 percent in 1940, 87 percent in 1941, 79 percent in 1942, 85 percent in 1943, and 93 percent in 1944. This ratio rose to over 94 percent in the first 4 months of 1945, with a reported capacity of about 5,030,000 barrels at operating refineries and a daily average of total crude run to stills of 4,745,000 barrels. These figures indicate that any further sustained increase in the amount of crude refined would be limited by the ability to increase the operating ratio further or by reopening the relatively small capacity of shut-down refineries that were in good condition and located near sources of available crude supply.

AVIATION GASOLINE

The Bureau of Mines initiated the collection of monthly data for aviation gasoline in October 1939. The Census of Manufacturers for 1939 showed a production of aviation gasoline at refineries for that year of about 9.4 million barrels. Exports of aviation gasoline were first shown separately in 1939 and totaled 4.2 million barrels. Assuming a substantial increase in stocks during the year, the domestic demand for aviation gasoline in 1939 was probably not much more than 3 million barrels. In 1940 the production of all grades of aviation gasoline amounted to 14.7 million barrels, and total demand was 11.3 million barrels—representing an export of 4.6 million and a domestic demand of 6.7 million. Production in 1941 rose to 21.1 million barrels and total demand to 17.7 million, with exports of 7.5 million barrels and a domestic demand of 10.2 million.

After the United States entered the war in December 1941, the expansion in the production of aviation gasoline became one of the major supply problems. A program for the construction of new plants was initiated by the Petroleum Administration for War, and the objectives as to quantity and quality continued to rise. In 1943 and 1944 the production of all grades of aviation gasoline in the United States expanded rapidly and according to published estimates materially exceeded an average of 500,000 barrels daily in 1944. The production of 100 octane or above constituted about 40 percent of the total output in 1941 and rose to about two-thirds of the total in 1944.

The expansion in the production of aviation gasoline was so great in 1944 as to offset the war decline in the civilian consumption of

motor fuel and to raise the total production and demand for motor fuel to new record levels.

MOTOR FUEL

The total demand for motor fuel since 1941 has been affected by a major decline in civilian consumption in the United States and a later rapid expansion in war requirements for our armed forces and for export to other Allied Nations. It was not until 1944 that the rise in military consumption exceeded the decline in civilian uses. The total demand for motor fuel reached a prewar peak of 695 million barrels in 1941, progressively declined to 624 million barrels in 1942 and 620 million barrels in 1943, and rose to a new record of 737 million barrels in 1944. The total increase of 117 million barrels in 1944 compared with 1943 represented gains of 68 million barrels in domestic demand and 49 million in exports. It should be noted that domestic demand includes all consumption by our armed forces at home and abroad, since overseas shipments to our armed forces are not included

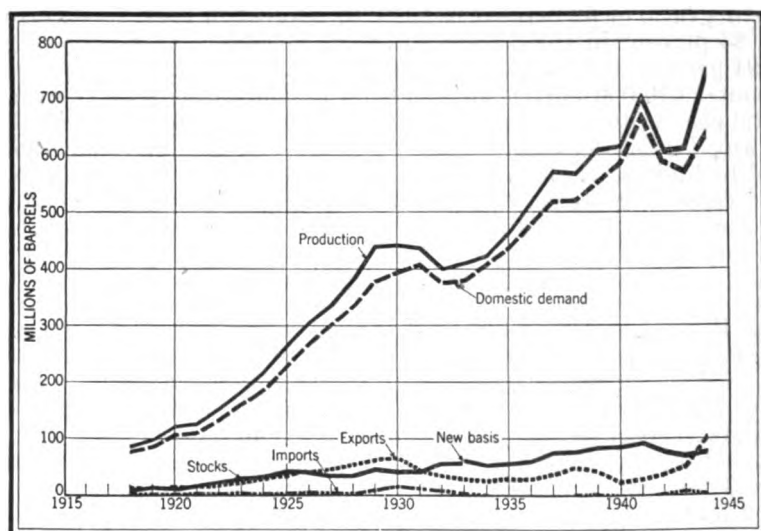


FIGURE 8.—Trends of production, domestic demand, exports, imports, and stocks of motor fuel in the United States, 1918-44.

in the export figures compiled by the United States Department of Commerce.

Exports.—Exports of motor fuel, including shipments to noncontiguous Territories, almost doubled, increasing from about 52 million barrels in 1943 to 101 million in 1944. Shipments to noncontiguous Territories declined from 3.6 million barrels in 1943 to 2.3 million in 1944. Exports to foreign countries increased from 48.4 million barrels in 1943 to 98.4 million in 1944. The major part of the exports in 1943 and 1944 went to other Allied Nations engaged in the war effort. Exports to the United Kingdom rose from 31.1 million barrels in 1943 to 75.9 million in 1944. In anticipation of the landing in northern France, a considerable volume of motor fuel was included in these exports in 1944 that entered a storage pool and was returned under reverse lend-lease arrangements to our armed forces.

Comparative analyses of statistics for motor fuel in the United States in 1944, by months¹

[Thousands of barrels]

	1944						
	Jan.	Feb.	March	April	May	June	July
Production:							
Refinery gasoline:							
Cracked.....	30,896	29,888	31,905	30,492	31,510	31,959	33,062
Straight-run.....	20,679	19,857	21,148	21,185	22,352	22,510	22,748
Natural gasoline, etc.....	7,821	7,665	8,050	7,828	8,277	8,187	8,567
Less L. P. G. sales and transfers of cycle products.....	1,213	1,222	1,158	1,321	1,148	1,137	1,097
Benzol.....	200	200	200	200	200	200	200
Total production.....	58,383	56,288	60,145	58,384	61,191	61,719	63,480
Daily average.....	1,883	1,941	1,940	1,946	1,974	2,057	2,048
Imports.....	12	10	262	475	925	262	138
Exports.....	5,172	5,694	5,404	7,302	9,496	11,646	9,582
Daily average.....	167	196	174	243	306	388	309
Stocks, end of period:							
Finished gasoline.....	69,390	72,909	75,275	76,638	74,519	70,246	68,921
Natural gasoline.....	4,296	4,245	4,242	4,213	4,436	4,477	4,425
Total stocks.....	73,686	77,154	79,517	80,851	78,955	74,723	73,346
Domestic demand.....	47,942	47,136	52,640	50,223	54,516	54,567	55,413
Daily average.....	1,547	1,625	1,698	1,674	1,759	1,819	1,788

	1944—Continued						1943 (total)
	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Production:							
Refinery gasoline:							
Cracked.....	33,769	32,283	33,190	33,055	33,558	385,567	314,454
Straight-run.....	22,655	23,827	24,421	24,019	24,543	289,944	218,773
Natural gasoline, etc.....	8,592	8,448	8,890	8,824	8,997	100,046	87,716
Less L. P. G. sales and transfers of cycle products.....	1,152	1,084	1,187	1,256	1,498	14,473	13,163
Benzol.....	200	200	200	200	200	2,400	2,400
Total production.....	64,064	63,674	65,514	64,842	65,800	743,484	608,180
Daily average.....	2,067	2,122	2,113	2,161	2,123	2,031	1,666
Imports.....	227	373	55	320	89	3,148	5,736
Exports.....	11,045	9,067	10,967	7,504	7,760	100,639	51,577
Daily average.....	356	302	354	250	250	275	141
Stocks, end of period:							
Finished gasoline.....	66,542	64,914	65,886	68,107	73,622	73,622	63,864
Natural gasoline.....	4,211	4,141	4,160	4,334	4,252	4,252	4,541
Total stocks.....	70,753	69,055	70,046	72,441	77,874	77,874	68,405
Domestic demand.....	55,839	56,678	53,611	55,283	52,696	636,524	568,238
Daily average.....	1,801	1,889	1,729	1,842	1,700	1,739	1,557

¹Subject to revision.

Domestic demand.—The trend in the domestic demand for motor fuel in the postwar period will be a major factor in determining the total demand for all oils. The volume of gasoline consumed by civilian motor vehicles has been reduced to about two-thirds normal by rationing and the decline in the total number of vehicles in operation. The recovery of this market will depend on the future volume of new car production in relation to the higher rate of scrapping incident to the greater average age of vehicles now in use. By the end of 1944 the expansion in the military consumption of motor fuel for aviation and transport had almost offset the decline in civilian demand. Although

aviation and military demand will be much higher after the war than in the prewar period the total will be relatively small compared with automotive demand. Presumably, it will take several years for the total domestic demand for motor fuel to equal the peak demand before the war.

The domestic demand for motor fuel, including military consumption in continental United States and all shipments to our armed forces abroad, declined from about 668 million barrels in 1941 to 589 million in 1942 and 568 million in 1943 and then rose to almost 637 million barrels in 1944. Thus, even in 1944, domestic demand was 31 million barrels less than the record demand in 1941.

The primary factor in the domestic demand for motor fuel is the consumption by motor vehicles. Normally, automotive or highway uses of motor fuel constitute about 88 percent of total domestic demand. Without comprehensive data on the distribution of military consumption and stocks at home and abroad, it has not been possible to make the usual estimates of motor-fuel consumption in the United States by uses and by types of vehicles. Under war conditions, total consumption by States can only be approximated because of the large sales to the Government and the lack of information as to their final distribution.

The major changes in demand have resulted from the reduction in civilian consumption due to rationing and the unprecedented war demands for aviation and military transport and mechanized operations.

Data compiled from State tax returns by the Public Roads Administration, Federal Works Agency, show the trends of total civilian consumption for private, State, and Federal uses. The reports of the Public Roads Administration account for a total distribution for highway use, nonhighway use, and losses of 636 million barrels of motor fuel in 1941, 540 million in 1942, and 449 million in 1943. These figures indicate a decline of 187 million barrels, or over 29 percent, in civilian demand in 1943 compared with 1941. This total decline represented about 96 million barrels in 1942 and 91 million barrels in 1943.

According to the Public Roads Administration, the consumption of motor fuel for highway uses declined from 576 million barrels in 1941 to 475 million in 1942 and to 381 million in 1943—a total decline of 195 million barrels or almost 34 percent. Although no data are available by types of vehicles, the decline for private automobiles was relatively much greater than for commercial vehicles. Consumption for non-highway purposes rose from 53 million barrels in 1941 to over 59 million in 1942 and to 63 million in 1943. The most important factor in this increase was the gain in consumption for agricultural uses.

Although final figures for 1944 are not available, the monthly data indicate a moderate increase in both highway and nonhighway uses for the year.

Distribution of domestic motor-fuel demand, 1925-43¹

(Thousands of barrels of 42 gallons)

Year	Motor-fuel demand		Buses	Passenger cars			Trucks		
	Total	Automotive		Highway ²	City ²	Total	Highway ²	City ²	Total
1925.....	226,329	201,433	3,391	80,653	74,285	154,938	8,466	34,638	43,104
1926.....	264,391	235,308	4,649	93,666	87,573	181,239	10,131	39,289	49,420
1927.....	299,818	266,839	5,458	105,553	100,430	205,983	12,068	43,329	55,397
1928.....	332,033	295,509	7,248	115,422	112,075	227,497	14,295	46,469	60,764
1929.....	375,999	334,649	9,894	128,948	127,956	256,899	17,417	50,929	68,346
1930.....	394,800	351,372	10,885	133,454	136,893	270,347	19,765	50,375	70,140
1931.....	408,418	369,042	11,468	134,276	142,552	276,828	22,132	48,614	70,746
1932.....	373,900	332,771	10,530	122,705	134,998	257,703	22,303	42,235	64,538
1933.....	377,003	335,533	10,110	122,283	135,895	258,178	24,157	43,088	67,245
1934.....	407,106	362,324	9,640	130,403	146,283	276,686	28,305	47,693	75,998
1935.....	434,810	386,981	9,750	138,641	153,985	292,626	32,999	51,606	84,605
1936.....	481,606	428,629	10,560	153,868	167,645	321,513	38,444	58,112	96,556
1937.....	519,352	462,223	11,450	163,270	177,840	341,110	46,339	63,324	109,663
1938.....	523,003	465,473	11,765	163,124	179,387	342,511	50,118	61,079	111,197
1939.....	555,509	494,403	12,300	171,977	186,867	358,844	57,022	66,237	123,259
1940.....	589,490	524,646	13,600	180,789	195,823	376,612	64,513	69,921	134,434
1941.....	667,505	583,957	15,000	202,952	221,758	424,710	70,147	74,100	144,247
1942.....	589,110	474,625	17,600	151,591	176,371	327,962	61,944	67,119	129,063
1943.....	568,238	384,332	18,200	112,754	131,874	244,628	58,112	63,392	121,504

¹ Not available for 1944.² Revised figures.*Motor-fuel consumption per motor-vehicle unit in use on July 1, 1940-43¹*

Year	Passenger cars			Trucks		
	Consumption (thousands of barrels)	Number of vehicles	Consumption per unit (barrels)	Consumption (thousands of barrels)	Number of vehicles	Consumption per unit (barrels)
1940 ²	376,612	25,385,900	14.84	134,434	4,531,700	29.67
1941 ²	424,710	27,709,200	15.33	144,247	4,788,300	30.12
1942 ²	327,962	26,946,600	12.17	129,063	4,801,400	26.88
1943 ²	244,628	25,127,800	9.74	121,504	4,633,000	26.23
1944 ³						

¹ Excludes gasoline consumed by buses and for nonautomotive uses.² Subject to revision.³ Not available.

Production.—The total production of motor fuel showed a substantial gain in 1944—from 608,180,000 barrels in 1943 to 743,484,000 in 1944—and exceeded the previous record of production in 1941 by 45,003,000 barrels. The production in 1944 comprised 385,567,000 barrels of cracked gasoline, 269,944,000 barrels of straight-run gasoline, 85,573,000 barrels of net natural gasoline and cycle-plant products (after deducting sales of liquefied gases for fuel purposes and transfers), and 2,400,000 barrels of benzol. The production of cracked gasoline increased about 71 million barrels, the production of straight-run gasoline showed a gain of 53 million barrels, and motor fuel produced at natural gasoline and cycle plants rose 11 million barrels.

Yields.—The yield of gasoline from crude petroleum declined from 44.2 percent in 1941 to 39.8 percent in 1942 and 37.1 percent in 1943 but rose to 39.4 percent in 1944. The decline in yield reflected the rapid decline in civilian consumption under rationing before the great expansion of military requirements for aviation and motor transport. However, the increase in war requirements and exports in 1944 more

Production of gasoline in the United States in 1944, by methods of manufacture, districts, and months¹

[Thousands of barrels]

Method and district	January	February	March	April	May	June	July	August	September	October	November	December	Total
Cracked:													
East Coast.....	5,031	4,603	5,272	4,625	5,050	4,710	5,102	5,141	4,815	5,366	5,059	4,984	59,758
Appalachian.....	1,364	1,273	1,298	1,206	1,272	1,283	1,373	1,407	1,268	1,267	1,358	1,305	15,644
Indiana, Illinois, Kentucky, etc.....	6,195	6,065	6,246	5,902	6,232	6,277	6,373	6,097	5,956	6,148	6,178	6,526	74,215
Oklahoma, Kansas, Missouri, etc.....	2,908	2,680	2,644	2,484	2,736	2,709	2,968	3,032	2,932	3,039	2,891	3,179	34,332
Texas Inland.....	7,145	7,155	7,140	7,284	7,189	7,274	7,231	7,480	7,513	7,493	7,549	7,992	85,945
Texas Gulf Coast.....	7,521	7,464	8,293	8,199	8,270	8,688	8,727	8,846	8,301	8,524	8,252	7,960	99,045
Louisiana Gulf Coast.....	4,411	4,556	4,533	4,552	4,444	4,484	4,501	4,743	4,685	4,704	4,812	4,261	53,351
Arkansas and Louisiana Inland.....	313	282	277	285	256	368	323	329	361	366	355	387	4,446
Rocky Mountain.....	684	733	677	692	840	771	818	980	889	814	767	807	9,365
California.....	4,284	4,075	4,003	4,263	4,201	4,305	4,646	4,714	4,563	4,469	4,633	4,809	53,365
Total cracked.....	30,896	29,888	31,905	30,492	31,510	31,959	33,062	33,769	32,283	33,190	33,055	33,558	385,567
Percent yield ²	23.2	23.5	23.1	23.1	22.6	22.8	23.0	23.6	23.0	23.1	23.6	23.1	23.2
Straight-run:													
East Coast.....	2,081	2,312	2,162	2,341	2,049	2,551	2,625	2,479	2,402	2,465	2,270	2,903	28,540
Appalachian.....	731	632	664	679	585	579	657	666	704	773	663	746	8,109
Indiana, Illinois, Kentucky, etc.....	4,945	4,285	4,808	4,318	4,897	4,761	4,559	5,426	5,028	5,248	5,230	5,317	59,150
Oklahoma, Kansas, Missouri, etc.....	2,356	2,179	2,320	2,350	2,320	2,404	2,283	2,469	2,601	2,598	2,638	2,600	29,107
Texas Inland.....	1,810	1,639	1,890	1,700	1,855	1,943	2,093	1,969	1,893	1,879	1,947	1,754	22,302
Texas Gulf Coast.....	3,434	3,577	4,242	4,610	4,732	4,562	4,582	4,484	5,074	5,083	5,401	5,132	54,953
Louisiana Gulf Coast.....	362	514	578	577	899	1,105	1,501	1,163	1,460	1,595	1,633	1,039	11,769
Arkansas, Louisiana Inland, and Mississippi.....	466	484	492	469	471	431	338	385	383	412	352	384	5,067
Rocky Mountain.....	868	731	755	610	773	801	744	692	876	798	788	801	9,589
California.....	3,686	3,486	3,227	3,601	3,770	3,255	3,056	2,892	3,406	3,647	3,795	3,737	41,558
Total straight-run.....	20,679	19,857	21,148	21,185	22,332	22,510	22,748	22,655	23,827	24,421	24,019	24,543	269,944
Percent yield ²	15.5	15.7	15.4	16.0	16.0	16.1	15.9	15.8	16.9	17.0	17.1	16.9	16.2
Total production, including natural gasoline:													
East Coast.....	7,257	6,945	7,648	7,028	7,217	7,422	7,917	7,813	7,392	8,027	7,607	8,098	90,371
Appalachian.....	2,141	1,993	1,970	1,917	1,889	1,893	2,069	2,102	2,002	2,073	2,057	2,067	24,163
Indiana, Illinois, Kentucky, etc.....	11,791	11,098	11,806	10,948	11,861	11,706	11,914	12,208	11,782	12,327	12,240	12,685	142,276
Oklahoma, Kansas, Missouri, etc.....	5,728	5,173	5,362	5,223	5,472	5,642	5,630	5,965	5,943	6,113	5,988	6,250	68,289
Texas Inland.....	3,668	3,535	3,645	3,663	3,787	3,890	4,003	4,029	3,976	4,110	4,195	4,018	46,519
Texas Gulf Coast.....	12,522	12,243	14,097	14,049	14,441	14,961	15,460	15,440	15,248	15,467	15,513	14,798	174,239
Louisiana Gulf Coast.....	2,146	2,410	2,579	2,524	2,705	2,996	3,381	3,330	3,541	3,722	3,447	3,542	36,324
Arkansas, Louisiana Inland, and Mississippi.....	923	881	902	868	856	924	846	885	900	932	866	903	10,686
Rocky Mountain.....	1,567	1,500	1,515	1,403	1,660	1,732	1,683	1,791	1,884	1,753	1,653	1,843	19,984
California.....	9,214	8,711	8,906	9,096	9,171	8,732	9,072	8,945	9,241	9,307	9,617	9,885	109,867
Total United States: 1944.....	56,957	54,369	58,430	56,689	59,060	59,898	61,975	62,508	61,909	63,631	63,183	64,109	722,718
1943.....	45,125	41,699	45,001	44,540	47,011	47,915	49,521	52,811	53,647	55,386	54,051	55,718	592,425

¹ Subject to revision. ² Based upon crude runs to stills.

than offset the civilian decline, and the record production of motor fuel was obtained from increased crude runs and a higher yield. The yield of cracked gasoline rose from 22.0 percent in 1943 to 23.2 percent in 1944, and the yield of straight-run gasoline increased from 15.1 percent to 16.2 percent.

Prices.—There were few changes in the representative prices for gasoline in 1944, although a slight downward trend occurred toward the end of the year.

The average group-3 refinery price for Regular-grade gasoline reached the ceiling price of 6.00 cents per gallon in September 1943 and showed no change until August 1944 when it dropped to 5.93 cents per gallon. A further decline to 5.88 cents a gallon occurred in September and remained in effect for the rest of the year.

The average 50-city dealers' net price, exclusive of all taxes, rose from 10.45 cents per gallon in 1943 to 10.49 cents per gallon in 1944. It remained at 10.51 cents per gallon from January to August, inclusive, and then dropped to 10.46 cents per gallon for the rest of the year.

The average 50-cities service-station price for gasoline (including State and local taxes but excluding Federal taxes) was 19.03 cents per gallon in 1943 and 19.09 cents per gallon in 1944. It remained constant at 19.10 cents for the first 9 months of 1944 and declined to 19.05 cents for the last 3 months.

Average monthly prices of gasoline in the United States, 1943-44, in cents per gallon

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1943													
Monthly average at refineries in Oklahoma, 72-74 octane ¹	5.94	5.94	5.94	5.94	5.94	5.94	5.94	5.96	6.00	6.00	6.00	6.00	5.96
Average of 50 cities on 1st of month: ²													
Dealer's net (ex. tax)....	10.37	10.39	10.40	10.40	10.40	10.40	10.50	10.46	10.51	10.51	10.51	10.51	10.45
Service station (including State and local taxes).....	18.93	18.97	18.98	18.97	18.98	18.99	19.08	19.05	19.05	19.10	19.10	19.10	19.03
1944													
Monthly average at refineries in Oklahoma, 72 octane ¹	6.00	6.00	6.00	6.00	6.00	6.00	6.00	5.93	5.88	5.88	5.88	5.88	5.95
Average of 50 cities on 1st of month: ²													
Dealer's net (ex. tax)....	10.51	10.51	10.51	10.51	10.51	10.51	10.51	10.51	10.46	10.46	10.46	10.46	10.49
Service station (including State and local taxes).....	19.10	19.10	19.10	19.10	19.10	19.10	19.10	19.10	19.10	19.05	19.05	19.05	19.09

¹ National Petroleum News.

² American Petroleum Institute; compiled by The Texas Co.

There was no change in the average tax rates in 1944 compared with 1943. The average State tax remained at 4.42 cents per gallon, the Federal tax at 1.50 cents per gallon, and the average local tax at 0.05 cent per gallon. The average total for all taxes amounted to 5.97 cents per gallon in both years.

Stocks.—Stocks of finished and unfinished gasoline amounted to 94 million barrels at the end of 1941, fell to 80 million barrels at the end of 1942, showed a further decline to 75 million barrels at the end of 1943, and rose to 87 million barrels at the end of 1944. Stocks of finished gasoline were reduced 15 million barrels in 1942 and 6 million barrels in 1943. The increase of almost 10 million barrels in 1944 represented a gain of over 1 million barrels in California and an increase of less than 9 million in areas east of California.

Gasoline stocks are computed in terms of days' supply by dividing the stocks at the end of the month by the daily average demand (domestic demand plus exports) for the succeeding month. Upon this basis the days' supply represented by finished gasoline stocks on December 31 was 51.0 days at the end of 1941 compared with 55.9 days at the end of 1942, 37.9 days at the end of 1943, and 36.9 days at the end of 1944.

The stocks included in these figures represent gasoline held at refineries and bulk terminals and by pipe lines but do not include gasoline that has passed into the custody of the armed forces.

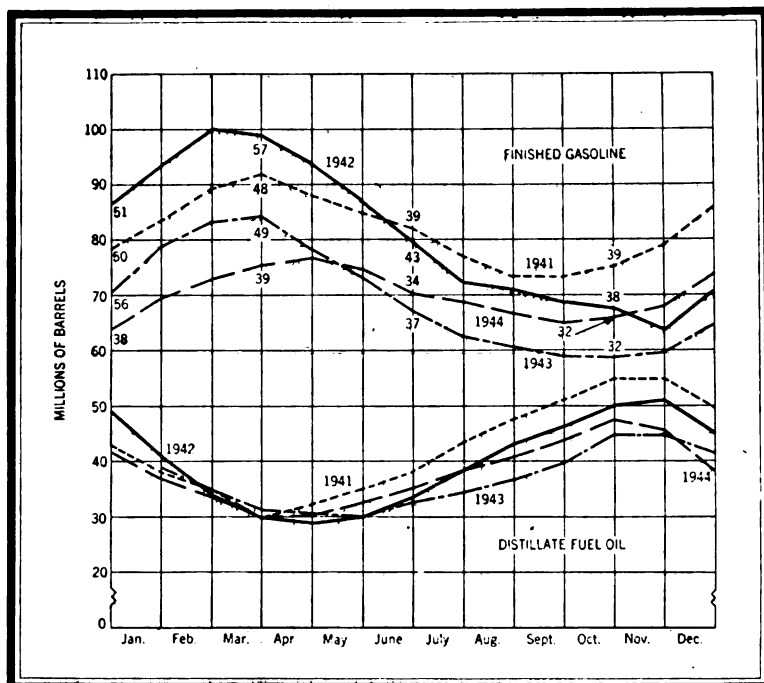


FIGURE 9.—Stocks of finished gasoline in the United States, 1941-44, by months, with figures representing days' supply at certain periods; also stocks of distillate fuel oil, 1941-44, by months.

Days' supply¹ of motor fuel on hand in the United States at end of month, 1942-44

Month	1942			1943			1944 ²		
	Fin- ished gasoline	Nat- ural gasoline	Total motor fuel	Fin- ished gasoline	Nat- ural gasoline	Total motor fuel	Fin- ished gasoline	Nat- ural gasoline	Total motor fuel
January.....	58.6	3.0	61.6	56.7	3.6	60.3	38.1	2.4	40.5
February.....	57.9	3.0	60.9	57.4	3.4	60.8	38.9	2.3	41.2
March.....	56.8	3.2	60.0	49.1	3.2	52.8	39.3	2.2	41.5
April.....	52.8	3.4	56.2	45.3	3.1	48.4	27.1	2.1	39.2
May.....	49.0	3.7	52.7	38.9	2.9	41.8	33.8	2.0	35.8
June.....	42.9	3.5	46.4	36.9	2.8	39.7	33.5	2.1	35.6
July.....	43.0	3.9	46.9	33.7	2.7	36.4	32.0	2.0	34.0
August.....	41.2	3.7	44.9	32.2	2.6	34.8	30.4	1.9	32.3
September.....	39.8	3.5	43.3	31.7	2.5	34.2	31.2	2.0	33.2
October.....	37.6	3.0	40.6	32.4	2.4	34.8	31.5	2.0	33.5
November.....	46.6	3.6	50.2	35.6	2.8	38.4	34.9	2.2	37.1
December.....	55.9	3.7	59.6	37.9	2.7	40.6	35.9	2.1	39.0

¹ Stocks divided by the daily average total demand (domestic demand plus exports) for succeeding month.

² Subject to revision; new stock basis for 1944 due to transfer of 1,100,000 barrels of finished gasoline to unfinished gasoline stocks.

Stocks of gasoline in the United States in 1944, by districts and months¹

[Thousands of barrels]

District	January 31	February 29	March 31	April 30	May 31	June 30	July 31	August 31	September 30	October 31	November 30	December 31
Finished gasoline: ²												
East Coast.....	10,685	10,745	10,108	10,249	10,163	10,118	9,898	9,944	10,193	10,716	10,918	10,583
Appalachian.....	2,735	2,903	2,976	3,925	3,581	2,917	3,927	3,221	3,190	3,188	3,966	3,703
Indiana, Illinois, Kentucky, etc.	16,664	18,153	19,504	19,320	19,680	17,397	17,311	16,317	13,236	14,173	13,758	18,804
Oklahoma, Kansas, and Missouri.....	6,848	7,633	7,533	7,739	7,249	6,573	6,863	5,863	6,066	6,496	6,730	7,610
Texas Inland.....	2,250	2,570	2,423	2,382	2,068	1,749	1,834	1,995	2,011	1,409	2,621	2,868
Texas Gulf Coast.....	11,662	11,778	12,442	12,753	12,108	11,448	11,703	11,392	11,211	11,405	11,827	13,071
Louisiana Gulf Coast.....	3,411	3,353	4,064	4,240	3,311	3,908	4,376	4,144	3,498	3,615	3,411	3,413
Arkansas and Louisiana Inland.....	1,916	2,052	2,088	2,274	2,392	3,042	2,777	2,669	3,498	3,615	3,411	3,413
Rocky Mountain.....	1,718	2,10	2,319	2,159	2,022	1,975	1,763	1,400	1,293	1,194	1,510	1,527
California.....	11,461	11,390	11,080	11,547	11,995	11,061	10,193	9,587	9,704	9,721	10,333	10,847
Total finished gasoline.....	69,390	72,909	75,275	76,638	74,519	70,246	68,921	66,542	64,914	65,886	68,107	73,622
Unfinished gasoline:												
East Coast.....	1,371	1,371	1,527	1,488	1,606	1,488	1,441	1,517	1,461	1,675	1,716	1,614
Appalachian.....	416	416	418	381	430	436	361	339	338	325	337	368
Indiana, Illinois, Kentucky, etc.	828	1,091	993	977	957	1,080	1,086	985	858	907	775	961
Oklahoma, Kansas, and Missouri.....	619	538	576	533	562	427	509	501	512	520	594	695
Texas Inland.....	353	384	431	416	504	450	407	421	444	402	410	441
Texas Gulf Coast.....	3,319	3,191	3,097	2,972	3,358	3,071	3,000	3,044	2,745	2,741	2,959	3,208
Louisiana Gulf Coast.....	683	708	588	573	591	463	546	637	906	918	863	988
Arkansas and Louisiana Inland.....	4	3	4	3	3	3	3	3	2	3	22	23
Rocky Mountain.....	108	102	138	194	257	216	230	285	171	200	207	203
California.....	4,220	4,156	4,338	4,201	3,835	4,104	3,993	4,242	4,635	4,687	4,671	4,779
Total unfinished gasoline.....	11,919	11,843	11,972	11,735	12,193	11,738	11,581	11,924	12,072	12,388	12,467	13,208
Total finished and unfinished:												
East Coast.....	12,056	12,116	11,635	11,737	11,769	11,606	11,339	11,461	11,654	12,391	12,634	12,197
Appalachian.....	3,151	3,312	3,394	4,306	3,971	3,353	3,388	3,560	3,468	3,513	3,983	4,071
Indiana, Illinois, Kentucky, etc.	17,490	19,184	20,739	20,297	20,937	18,477	18,400	17,302	16,063	16,080	16,565	19,765
Oklahoma, Kansas, and Missouri.....	7,467	8,171	8,309	8,292	7,811	7,000	6,392	6,394	6,607	7,234	7,271	8,285
Texas Inland.....	2,643	2,934	2,956	2,798	2,662	2,200	2,341	2,455	2,455	2,308	2,437	2,627
Texas Gulf Coast.....	14,981	14,939	15,509	15,755	15,506	14,516	14,703	14,436	13,956	14,176	14,786	15,177
Louisiana Gulf Coast.....	4,094	4,232	4,632	4,810	4,502	4,431	4,922	4,781	4,436	4,585	4,904	4,966
Arkansas and Louisiana Inland.....	1,920	2,055	2,192	2,277	2,345	3,045	2,880	2,702	2,610	2,468	2,436	2,436
Rocky Mountain.....	1,826	2,212	2,457	2,353	2,279	2,191	2,009	1,635	1,404	1,390	1,517	1,730
California.....	15,681	15,546	15,424	15,748	15,630	15,165	14,158	13,779	14,399	14,408	14,806	15,626
Total United States: 1944.....	81,309	84,752	87,247	88,373	86,712	81,984	80,502	78,466	76,986	78,274	80,574	86,830
1943.....	88,677	92,848	94,114	89,576	83,887	77,630	73,149	71,059	69,219	69,045	69,551	75,327

¹ Subject to revision.² Includes stocks of finished gasoline at refineries and bulk terminals and in pipe lines.

Production and consumption by States.—The refinery production of gasoline rose from 592,425,000 barrels in 1943 to 722,718,000 barrels in 1944. Texas was the largest producer, with 220,758,000 barrels or about 31 percent of the total in 1944, compared with 29 percent in 1943. California was the second State in importance, with a total output (including some production in Washington) of 109,867,000 barrels or about 15 percent of the total in both 1943 and 1944. No other State had a production that exceeded 7 percent of the total. Production in all the important States increased in 1944 compared with 1943. The upward trend in the Coastal States was continued and the Interior States that showed a decline in 1943 increased their output in 1944.

Production and consumption of gasoline in the United States, 1942-44, by States
[Thousands of barrels]

State	1942		1943		1944 ¹	
	Production	Consumption ²	Production	Consumption ²	Production	Consumption ²
Alabama.....	(³)	7,376	(³)	6,223	(³)	6,264
Arizona.....		3,029		3,043		3,078
Arkansas.....	4,033	4,923	3,392	4,272	3,116	4,268
California.....	85,248	53,220	91,783	59,396	109,867	79,890
Colorado.....	2,312	5,832	2,215	5,743	2,514	7,073
Connecticut.....		8,035		6,199		6,505
Delaware.....		1,300		1,143		1,195
District of Columbia.....		3,565		2,513		2,589
Florida.....		10,503		8,725		9,083
Georgia.....	3,104	9,096	4,289	8,308	7,518	8,979
Idaho.....	(³)	2,526	(³)	2,205	(³)	2,278
Illinois.....	46,825	33,707	43,646	27,728	53,145	27,770
Indiana.....	39,017	17,658	39,816	16,013	42,918	16,640
Iowa.....		12,951		11,534		11,938
Kansas.....	33,878	11,600	30,924	10,407	32,413	10,528
Kentucky.....	7,949	6,698	6,928	6,326	7,861	7,019
Louisiana.....	31,024	7,181	29,505	7,198	43,894	7,287
Maine.....		3,188		2,660		3,113
Maryland.....	(³)	7,463	(³)	6,447	(³)	7,033
Massachusetts.....	5,023	14,454	5,713	11,643	6,333	12,812
Michigan.....	11,078	28,613	10,427	23,306	11,103	25,806
Minnesota.....	(³)	13,030	(³)	10,534	(³)	11,029
Mississippi.....	(³)	6,079	(³)	4,850	(³)	4,899
Missouri.....	(³)	16,336	(³)	12,426	(³)	12,259
Montana.....	4,245	3,022	4,264	2,627	4,158	2,769
Nebraska.....	(³)	5,693	(³)	5,391	(³)	5,608
Nevada.....		1,160		1,006		1,466
New Hampshire.....		1,847		1,303		1,588
New Jersey.....	19,677	19,241	20,863	15,806	29,473	16,473
New Mexico.....	1,473	2,349	1,558	2,371	1,876	2,639
New York.....	8,220	37,746	7,323	30,192	8,371	33,155
North Carolina.....		10,132		9,112		9,721
North Dakota.....		3,928		3,670		4,074
Ohio.....	34,692	35,061	32,689	29,782	36,001	32,520
Oklahoma.....	31,071	10,067	29,392	9,526	35,876	11,379
Oregon.....		6,662		6,079		6,264
Pennsylvania.....	39,165	33,073	42,588	25,385	51,430	26,964
Rhode Island.....	(¹⁰)	2,839	(¹⁰)	2,465	(¹⁰)	2,873
South Carolina.....	(³)	5,189	(³)	4,492	(³)	4,715
South Dakota.....	(³)	3,419	(³)	3,113	(³)	3,182
Tennessee.....	(³)	8,591	(³)	7,574	(³)	7,951
Texas.....	167,681	41,453	174,206	62,494	220,758	97,718
Utah.....	(³)	2,697	(³)	2,432	(³)	2,490
Vermont.....		1,282		980		1,071
Virginia.....		9,596		9,175		10,317
Washington.....	(³)	10,410	(³)	9,597	(³)	8,989
West Virginia.....	2,529	4,664	2,466	3,626	2,757	3,799
Wisconsin.....	(³)	13,606	(³)	11,084	(³)	11,520
Wyoming.....	8,732	1,471	8,438	1,261	11,436	1,687
Total United States.....	586,971	562,461	592,425	519,355	722,718	600,267

¹ Subject to revision.

² American Petroleum Institute.

³ Alabama and Mississippi included with Louisiana.

⁴ Washington included with California.

⁵ Maryland and South Carolina included with Georgia.

⁶ Idaho and Utah included with Wyoming.

⁷ Minnesota and Wisconsin included with Illinois.

⁸ Missouri, Nebraska, and South Dakota included with Kansas.

⁹ Tennessee included with Kentucky.

¹⁰ Rhode Island included with Massachusetts.

The lack of information on military consumption at home and abroad makes it extremely difficult to compute total consumption of gasoline by States. The American Petroleum Institute notes that since the war began certain gasoline has moved on Government bill-of-lading that bypasses State inspection and may not be recorded by the receiving State and in other cases that sales to the Government within a State may be ultimately shipped abroad.

Distribution.—The normal movements of gasoline have been subject to drastic readjustments during the war. About 131 million barrels of gasoline were shipped by boat from the Gulf Coast to the East Coast in 1941. This movement was reduced to about 34 million barrels in 1942 and amounted to only 23 million barrels in 1944. The substitution of a major tank-car movement and the expansion of pipe-line deliveries to the East Coast succeeded in maintaining the flow of gasoline to supply the restricted civilian consumption and military requirements in that district, as well as a large volume of gasoline for shipment overseas. With the concentration of tank cars in this service, the pipe lines in the Central States were operated to capacity.

Total motor fuel delivered by pipe lines rose from 111 million barrels in 1941 to 125 million in 1942, increased to 204 million barrels in 1943, and showed a further gain to 278 million barrels in 1944.

Shipments of motor fuel by pipe lines in the United States in 1944, by months

[Thousands of barrels]

	1944						
	January	February	March	April	May	June	July
Motor fuel turned into lines.....	19,596	18,408	21,320	22,320	23,079	23,662	24,132
Motor fuel delivered from lines.....	19,110	17,964	19,688	20,586	22,929	23,782	23,734
Shortage.....	62	76	131	55	39	151	88
Stocks in lines and working tanks, end of month.....	8,877	9,245	10,746	12,425	12,536	12,265	12,575

	1944—Continued						1943 (total)
	August	September	October	November	December	Total	
Motor fuel turned into lines.....	25,511	26,211	26,333	26,617	25,863	283,052	206,512
Motor fuel delivered from lines.....	25,853	26,061	26,565	26,816	25,192	278,280	203,678
Shortage.....	142	48	160	85	64	1,101	953
Stocks in lines and working tanks, end of month.....	12,091	12,193	11,801	11,517	12,124	12,124	8,453

KEROSENE AND RANGE OIL

The kerosine situation improved statistically in 1944 as production, domestic demand, year-end stocks, and exports all showed gains. Imports of kerosine, which are small in relative volume and therefore unimportant from the supply angle, registered a decline in 1944.

Kerosine production increased by 8 percent from 72,270,000 barrels in 1943 to a record of 78,344,000 in 1944. This expanded output of kerosine in 1944 was entirely due to the running of a greater volume

of crude petroleum (approximately 17 percent over the 1943 total), as the yield was a negative factor, declining from 5.1 percent in 1943 to 4.7 percent in 1944. Petroleum refiners reduced the percentage yield of most products (kerosine, light and heavy fuel oil, and lubricating oil) in 1944 to increase the output of greatly needed motor fuel.

Comparative analyses of statistics for kerosine in the United States, 1943-44, by months and districts

Month and district	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks (thousands of barrels)	
	1943	1944 ¹	1943	1944 ¹	1943	1944 ¹	1943	1944 ¹
By months:								
January.....	5,602	7,071	5.0	5.3	8,098	7,999	7,222	8,267
February.....	5,852	6,413	5.7	5.1	6,955	7,286	5,942	7,359
March.....	6,326	6,980	5.6	5.0	7,057	7,457	4,868	6,567
April.....	6,299	6,489	5.6	4.9	8,285	8,923	5,326	6,722
May.....	6,511	6,710	5.7	4.8	5,075	5,016	6,486	8,117
June.....	6,060	6,246	5.2	4.5	4,186	4,148	8,237	9,825
July.....	5,769	6,277	4.8	4.4	4,020	3,574	9,195	11,799
August.....	5,394	6,358	4.3	4.4	3,751	3,868	10,286	13,339
September.....	5,817	6,339	4.6	4.5	4,384	4,818	10,910	14,648
October.....	5,977	6,515	4.6	4.5	5,516	6,305	11,299	14,454
November.....	6,188	6,606	4.9	4.6	6,682	6,741	10,487	13,771
December.....	6,525	6,461	5.0	4.5	7,619	8,810	9,359	11,150
Total United States.....	72,270	78,344	5.1	4.7	68,598	71,985	9,380	11,150
By districts:								
East Coast.....	7,561	9,458	3.9	3.7			3,062	4,359
Appalachian.....	3,697	3,894	6.7	6.9			308	561
Indiana, Illinois, Kentucky, etc.	14,370	13,665	5.4	4.9			2,314	2,362
Oklahoma, Kansas, and Missouri.....	8,470	7,767	6.8	5.8			656	704
Texas Inland.....	3,310	4,516	4.5	5.5	(?)	(?)	137	198
Texas Gulf Coast.....	22,060	22,380	6.6	5.5			1,365	1,205
Louisiana Gulf Coast.....	6,303	10,539	11.0	12.5			577	985
Arkansas and Louisiana Inland.....	2,304	2,512	8.5	9.0			213	148
Rocky Mountain.....	794	950	2.3	2.3			69	127
California.....	3,401	2,713	1.3	0.9			658	501
Total United States.....	72,270	78,344	5.1	4.7	68,598	71,985	9,859	11,150

¹ Subject to revision.

² Figures not available.

The higher production of kerosine in 1944 was the result of increased output in the Louisiana Gulf Coast, East Coast, and Texas Inland refinery districts. Kerosine production credited to the Louisiana Gulf Coast in 1944 increased by 67 percent over the 1943 quantity, while there was a recorded gain of 25 percent in the East Coast and a 36-percent expansion in the Texas Inland area. Production of kerosine in the important Texas Gulf Coast district showed little change in volume in 1944 over 1943, and furthermore the yield of the area dropped from 31 percent of the national total in 1943 to 29 percent in 1944. The output of kerosine in the Indiana-Illinois district, which is second in importance in quantity to that originating in the Texas Gulf Coast, declined by 5 percent in 1944 compared with 1943. Other areas reporting lower kerosine yields in 1944 than in 1943 were the Oklahoma-Kansas district (8 percent decline) and California, where the shrinkage was 20 percent.

The domestic demand for kerosine, which declined slightly in 1943, turned upward in 1944 in spite of rationing and distribution difficulties. Monthly figures for 1944 calculated from production, change in stocks, exports, and imports of kerosine show an indicated domestic market for 71,935,000 barrels in 1944—a 5-percent increase over the 1943 total of 68,598,000 barrels. It is impossible to present the domestic demand for kerosine by the various refinery districts, as import-export details for the corresponding areas are not available.

The export demand for kerosine, which nearly doubled in 1943 over 1942 because of improved shipping conditions, remained stationary in 1944 when the overseas market of 4,765,000 barrels varied little from the 1943 total of 4,752,000 barrels. The larger share of export kerosine went to the United Kingdom in 1944—4,167,000 barrels compared with 3,782,000 in 1943—and the quantity sent to Canada declined from 268,000 barrels in 1943 to 186,000 in 1944. Very little kerosine is imported into the United States, and the quantity has declined from 418,000 barrels in 1942 to 375,000 in 1943 and to only 147,000 in 1944.

Kerosine stocks, which declined in 1943, turned upward in 1944, when the year-end total of 11,150,000 barrels was 19 percent above the comparative inventory for 1943. The more important change took place in bulk terminal storage in 1944 which increased to 5,385,000 barrels compared with 3,887,000 in 1943. Kerosine held at refineries at the end of 1944—5,765,000 barrels—differed little from the 1943 total of 5,472,000 barrels. Days of supply of kerosine held in storage at the year end have dwindled under adverse war conditions from 61 days for 1941 to 38 days for 1943; however, there was a slight improvement in 1944, when the final inventory was sufficient for a 39-day period.

An improvement in the kerosine stock situation in the East Coast area in 1943 continued into 1944, when the final inventory of 4,359,000 barrels was 42 percent above the corresponding total for 1943. Furthermore, kerosine stocks in the important East Coast marketing area for 1944 represented 39 percent of the national total compared with a 33-percent share in 1943. A decline in kerosine stocks in the Texas Gulf Coast refinery district—the most important kerosine-producing area of the country—in evidence during the war years, continued into 1944, when the final inventory of 1,205,000 barrels was 12 percent below the comparative total for 1943. The drainage of the Texas Gulf kerosine supplies in 1944 lowered the quantity from 15 percent of the national total inventory in 1943 to 11 percent in 1944. Kerosine stocks in the Indiana-Illinois district—a supply area second only to the Texas Gulf—of 2,362,000 barrels at the end of 1944 differed only slightly from the 1943 total of 2,314,000 barrels. A pronounced drop in kerosine stocks in the Louisiana Gulf refinery district in 1943 was reversed in 1944, when a gain (985,000 barrels in 1944 compared with 577,000 in 1943) of 71 percent was reported. Lower production of kerosine in California in 1944 resulted in a 24-percent drop in inventory, the quantity declining from 658,000 barrels at the end of 1943 to 501,000 in 1944.

Sales of kerosine in the United States, 1942-43, by regions, States, and uses¹

[Thousands of barrels]

Region and State	Sold as range oil		Tractor fuel		All other uses		Total	
	1942	1943	1942	1943	1942	1943	1942	1943
Pacific Coast:								
California.....	91	61	20	21	1,376	2,136	1,487	2,218
Oregon.....	15	15	8		135	145	158	160
Washington.....	22	14	1		206	215	229	229
Arizona.....	16	7	28		185	226	229	233
Nevada.....	2	2			44	52	46	54
Rocky Mountain:								
Idaho.....	1	3	9	10	23	33	33	46
Montana.....	33	36	50	58	61	54	144	148
Wyoming.....	10	13	15	20	15	29	40	62
Utah.....	6	4	6	6	14	15	26	25
Colorado.....	32	34	55	49	57	81	144	164
New Mexico.....	20	60	45	43	86	59	151	162
North Central:								
North Dakota.....	71	73	158	145	55	77	284	295
South Dakota.....	94	80	141	154	76	74	311	308
Minnesota.....	335	312	191	192	503	404	1,029	908
Nebraska.....	154	260	132	139	170	200	456	599
Iowa.....	210	278	152	179	663	593	1,025	1,050
Wisconsin.....	240	292	105	179	518	482	863	953
Illinois.....	1,455	1,862	262	314	1,691	1,487	3,408	3,663
Indiana.....	198	257	183	245	1,281	1,007	1,662	1,509
Michigan.....	293	352	115	222	848	829	1,246	1,403
Ohio.....	354	553	221	238	728	600	1,303	1,391
Kentucky.....	70	131	79	101	585	489	734	721
Tennessee.....	97	163	99	117	497	695	693	975
South Central:								
Missouri.....	451	573	170	173	669	690	1,290	1,436
Kansas.....	136	176	297	314	231	345	664	835
Texas.....	552	851	766	1,183	1,949	2,343	3,267	4,377
Oklahoma.....	135	162	266	242	546	666	947	1,070
Arkansas.....	118	162	194	210	599	586	911	958
Louisiana.....	98	168	193	230	770	824	1,061	1,222
Mississippi.....	59	77	110	164	366	404	535	645
Alabama.....	76	154	97	103	406	537	579	794
New England:								
Maine.....	1,582	1,311	11	4	52	34	1,645	1,349
New Hampshire.....	884	810	8	1	36	10	928	821
Vermont.....	593	447	2	2	71	56	666	505
Massachusetts.....	11,467	9,920	1	2	416	312	11,884	10,234
Rhode Island.....	2,208	1,853	2	2	81	57	2,291	1,912
Connecticut.....	3,687	3,434			106	67	3,793	3,501
Middle Atlantic:								
New York.....	6,917	6,286	110	86	1,240	1,059	8,267	7,431
New Jersey.....	3,323	3,019	116	117	1,078	949	4,517	4,085
Pennsylvania.....	895	858	192	138	1,429	1,256	2,516	2,252
Delaware.....	84	85	3	1	61	56	148	142
Maryland.....	651	660	8	24	515	402	1,174	1,086
District of Columbia.....	104	96	5	9	72	66	181	171
South Atlantic:								
Virginia.....	191	224	17	22	598	619	906	865
West Virginia.....	59	47	14	16	150	116	223	179
North Carolina.....	775	768	72	91	719	651	1,566	1,510
South Carolina.....	191	230	45	64	422	480	658	754
Georgia.....	265	299	181	102	559	525	1,005	926
Florida.....	635	689	182	137	550	653	1,367	1,479
Total United States.....	39,945	38,221	5,137	5,869	23,606	23,725	68,690	67,815

¹ Figures for 1944 by States not yet available.

Oil dealers report their annual sales of kerosine to the Bureau of Mines by States and principal uses. The 1943 survey, recently completed, shows total kerosine sales of 67,815,000 barrels or a small decline from the 1942 quantity of 68,690,000 barrels. A review of the kerosine demand in recent years reveals that it increased from about 60,000,000 barrels in 1939 to about 68,000,000 in 1940 and that requirements have varied but slightly from the latter volume in the past 4 years.

A heavy loss in sales of kerosine was reported for the Atlantic Coast area (39,202,000 barrels in 1943 compared with 43,735,000 in 1942), largely due to strict rationing of supplies and distribution difficulties in that area. The most serious decline in kerosine deliveries in 1943 was realized in the New England area and in the Middle Atlantic States. All other districts reported gains in sales of kerosine in 1943, the expansion being more pronounced in the South Central and Pacific Coast States.

Kerosine reported delivered as range oil declined from 39,945,000 barrels in 1942 to 38,221,000 in 1943; furthermore, the range-oil proportion of kerosine sales declined from 58 percent of the national total in 1942 to 56 percent in 1943. About 8 percent of all kerosine is sold as tractor fuel, and the total increased by 14 percent from 5,137,000 in 1942 to 5,869,000 in 1943. Most of the demand for tractor fuel was reported from the North Central and South Central States, which took 83 percent of the total in 1943. "All other uses" of kerosine increased from 23,608,000 barrels in 1942 to 23,725,000 in 1943.

There were no changes in representative kerosine prices in 1944. The quotation for 41°-43° gravity, water-white kerosine at refineries in Oklahoma of 4.38 cents a gallon dating from September 9, 1943, held throughout 1944. The tank-wagon price of kerosine at Chicago—10.6 cents a gallon—first announced December 31, 1942, remained in force throughout 1944.

Sales of range oil in the United States, 1941-43, by States¹

[Thousands of barrels]

State	1941	1942	1943	
			Total	Percent of total
Massachusetts.....	13,187	11,682	10,251	23.3
New York.....	7,711	7,128	6,494	14.7
Connecticut.....	3,963	3,771	3,606	8.2
Illinois.....	2,185	2,789	3,281	7.4
New Jersey.....	3,626	3,449	3,085	7.0
Rhode Island.....	2,495	2,292	1,917	4.4
Maine.....	1,827	1,627	1,355	3.1
Michigan.....	712	934	1,025	2.3
Pennsylvania.....	949	919	891	2.0
Iowa.....	456	674	878	2.0
Texas.....	416	558	865	2.0
Wisconsin.....	616	781	856	1.9
New Hampshire.....	907	914	835	1.9
North Carolina.....	667	785	809	1.8
Minnesota.....	670	663	750	1.7
Florida.....	628	654	719	1.6
Missouri.....	477	553	700	1.6
Maryland.....	518	662	666	1.5
Ohio.....	457	472	634	1.4
Indiana.....	355	439	553	1.3
Vermont.....	638	593	452	1.0
Other States.....	2,650	2,584	3,473	7.9
Total United States.....	46,110	44,923	44,097	100.0

¹ Figures for 1944 by States not yet available.

FUEL OIL

War requirements approached a possible peak in 1944, and as a result domestic and export demands for fuel oil were raised to new levels. The domestic market for fuel oil in 1944 was 7 percent over the 1943 total, while the export demand was approximately 44 per-

cent above 1943. Suppliers were forced to draw on stocks again in 1944 to satisfy the trade, although production, transfers from crude, and imports were all higher than in 1943. The indicated domestic demand for fuel oil in 1944 was 720,337,000 barrels compared with 675,118,000 in 1943. Most of the increase was limited to the residual grades, which expanded by 9 percent from 467,008,000 barrels in 1943 to 510,797,000 in 1944, but the 1944 total for the distillate or light fuel oils of 209,540,000 barrels was less than 1 percent above the 1943 volume of 208,110,000 barrels. Exports of fuel oil increased from 39,851,000 barrels in 1943 to 57,172,000 in 1944; however, the gain was confined to the distillate oils, which expanded by 74 percent from 24,957,000 barrels in 1943 to 43,345,000 in 1944, whereas the foreign market for heavy fuel oils dropped by 7 percent from 14,894,000 barrels in 1943 to 13,827,000 in 1944.

A 19-percent increase in the domestic demand for fuel oil in the first quarter of 1944 over the corresponding period of 1943 was largely the result of higher industrial and military requirements as the weather, being milder, was not a factor. The indicated demand for residual grades, which are used largely as fuel in heavy industries, increased by 24 percent from 105,457,000 barrels in the opening quarter of 1943 to 130,936,000 for the same period of 1944, but the market for distillate fuel oils, about half of which are used for space heating, expanded at a lesser rate (9 percent) from 61,255,000 barrels in the first 3 months of 1943 to 66,620,000 in the 1944 quarter. Mild weather and the tapering off of the heating season resulted in a decline in the light fuel-oil demand in the second quarter of 1944, when the total of 44,384,000 barrels was 3 percent below corresponding requirements of 45,725,000 in 1943. Industrial consumption of heavy fuel oil remained at a fairly high level in the April-June quarter of 1944, the demand of 125,472,000 barrels being 11 percent over the total of 113,379,000 for the same period of 1943.

Salient statistics of fuel oil in the United States, 1943-44

[Thousands of barrels]

	1943			1944 ¹		
	Distillate fuel oil	Residual fuel oil	Total	Distillate fuel oil	Residual fuel oil	Total
Stocks at beginning of year:						
Refinery.....	32,659	49,961	82,620	27,816	38,855	66,671
Bulk terminal.....	12,281	11,822	24,103	13,912	9,629	23,541
Production.....	211,516	417,306	628,822	239,162	461,455	700,607
Transfers from crude oil to fuel oil:						
California.....	19	18,861	18,880	79	23,177	23,256
East of California.....	3,051	5,226	8,277	3,163	5,338	8,501
Imports.....	15,269	27,210	42,479	7,096	36,553	43,649
Exports.....	24,957	14,894	39,851	43,345	13,827	57,172
Stocks at end of year:						
Refinery.....	27,816	38,855	66,671	25,070	40,356	65,426
Bulk terminal.....	13,912	9,629	23,541	13,263	10,027	23,290
Indicated domestic demand:						
Class I railroads, purchases ²	(³)	(³)	121,070	(³)	(³)	121,188
Public-utility power plants ⁴	(³)	(³)	18,036	(³)	(³)	20,814
All other demands.....	(³)	(³)	536,012	(³)	(³)	578,335
	208,110	467,008	675,118	209,540	510,797	720,337

¹ Subject to revision.

² Interstate Commerce Commission; total includes Diesel fuel.

³ Figures not available.

⁴ Federal Power Commission.

The market for fuel oil was unusually high in the third quarter of 1943, and 1944 requirements did not reach the same level. The indicated demand for distillates—39,424,000 barrels in the quarter—was 12 percent below the 1943 total of 44,802,000, but the decline for residual grades was less pronounced—only 2 percent—or from 118,722,000 barrels in the third quarter of 1943 to 115,841,000 for the corresponding months in 1944. The demand for heating oils again became a factor in the closing quarter of 1944, when deliveries of light grades of fuel oil of 59,112,000 barrels were 5 percent over 1943 requirements of 56,328,000, and residual grades totaling 138,548,000 barrels represented an expansion of 7 percent over the 1943 market of 129,540,000 barrels.

The annual survey of the Bureau covering the distribution of fuel-oil sales by States and uses in 1944 is incomplete, so all that is known about the principal demands at this time is taken from monthly releases of Government and other agencies. An estimate based on monthly statements of the Interstate Commerce Commission places fuel-oil requirements of the railroads at 125,000,000 barrels in 1944, a total little different from 1943 purchases of 124,886,000 barrels. The market for fuel-oil bunkers for vessels plying in foreign trade continued to expand in 1944 as it did in 1943, according to statistics compiled by the Bureau of the Census. That agency reported a total of 69,753,000 barrels of fuel oil loaded on vessels for bunkers at American continental ports in 1944—a 46-percent gain over the 1943 demand of 47,880,000 barrels. Requirements for bunker oil by vessels operating in coastwise traffic probably did not expand proportionately in 1944; however, it is believed that total fuel-oil bunkers—both foreign and coastwise—may have reached 98,000,000 barrels in 1944 or a gain of 34 percent over 1943 deliveries of 73,265,000 barrels.

Monthly publications of the Federal Power Commission show consumption of 20,814,000 barrels of fuel oil by public-utility power plants in 1944, a 15-percent increase over the 1943 total of 18,036,000 barrels. Manufactured-gas companies used 18,390,000 barrels of fuel oil in 1943, according to statistics released by the American Gas Association, and it is believed that 1944 requirements probably rose to 19,500,000 barrels. This estimate for the manufactured-gas companies in 1944 plus the known consumption of 20,814,000 barrels of fuel oil by electric-power plants indicate a total demand of approximately 40,300,000 in 1944 for the public utilities—a 9-percent gain over 1943 purchases of 36,812,000 barrels.

Oil companies reported sales of 99,344,000 barrels of fuel oil to smelters, mines, and manufacturing plants in 1943. In view of conservation, forced conversion to other fuels, and supply difficulties in some areas, it is not anticipated that the 1944 demand for fuel oil by these industries, when known, will have shown any great increase and the total is estimated at 103,000,000 barrels—a 4-percent gain over 1943.

Deliveries of fuel oil for space heating dropped in 1943 owing to strict enforcement of ration regulations, shifts to other fuels, distribution difficulties, and the diversion of supplies for military use; and furthermore, 1944 totals when available may show another small decline. It is estimated that deliveries of fuel oil for heating totaled 151,000,000 barrels in 1944 compared with 155,251,000 in 1943. The 1944 quantity represents 110,000,000 barrels of distillate grades

(112,581,000 in 1943) and 41,000,000 of heavy fuel oil (42,670,000 in 1943) for the heating of buildings.

The use of No. 1 fuel oil for range burners showed a gain of 18 percent in 1943 over 1942, as it is believed that some users turned more to this kind of heating in order to save fuel ordinarily consumed in central heating plants. Deliveries of No. 1 fuel oil for range burners

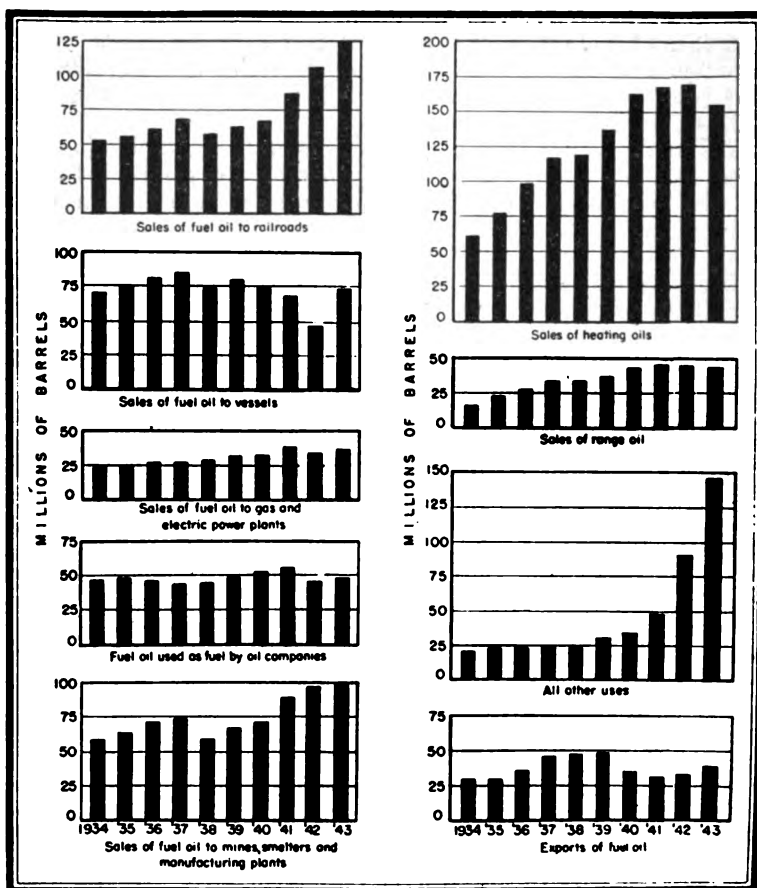


FIGURE 10.—Sales of fuel oil and range oil in the United States, 1934-43, by uses.

increased from 4,978,000 barrels in 1942 to 5,876,000 in 1943, and it is estimated that the 1944 demand was 6,000,000 barrels or over.

Crude-oil production increased about 11 percent in 1944 compared with 1943, and runs to stills were approximately 17 percent over the 1943 total, so it is believed that oil companies consumed about 54,000,000 barrels of fuel oil in their field, pipe-line, and refinery operations in 1944—about a 13-percent gain compared with 1943 requirements of 48,007,000 barrels. All other uses of fuel oil, including military demands, probably totaled 143,000,000 barrels in 1944.

Sales of fuel oil¹ and of range oil in the United States, 1939-43, by uses²

[Thousands of barrels]

Use	1939	1940	1941	1942	1943
Fuel oil:					
Railroads.....	63, 235	68, 098	85, 510	106, 484	124, 886
Ships' bunkers (including tankers).....	79, 254	74, 803	67, 635	46, 717	73, 265
Gas and electric power plants.....	32, 039	32, 795	38, 774	33, 805	36, 812
Smelters, mines, and manufacturing industries.....	67, 043	73, 940	88, 387	97, 132	99, 344
Heating oils.....	136, 232	160, 379	167, 514	168, 989	165, 251
Fuel oil (No. 1) sold as range oil.....	3, 220	3, 977	4, 449	4, 978	5, 876
Oil company fuel.....	49, 045	81, 928	55, 297	45, 935	48, 007
All other uses.....	26, 875	32, 838	46, 763	88, 106	146, 748
Total United States.....	466, 943	498, 758	554, 329	592, 146	690, 189
Exports and shipments to noncontiguous Territories.....	49, 505	35, 249	31, 039	33, 670	39, 851
Total.....	506, 448	534, 007	585, 368	625, 816	730, 040
Range oil.....	37, 061	44, 692	46, 110	44, 923	44, 997

¹ Includes distillate fuel oil, residual fuel oil, and some crude oil burned as fuel.² Figures for 1944 not yet available.*Sales of distillate fuel oil¹ in the United States, 1939-43, by uses²*

[Thousands of barrels]

Use	1939	1940	1941	1942	1943
Railroads.....	2, 258	3, 194	4, 945	6, 488	8, 608
Ships' bunkers (including tankers).....	14, 108	13, 249	10, 957	8, 900	11, 089
Gas and electric power plants.....	4, 131	4, 561	5, 152	5, 704	5, 954
Smelters, mines, and manufacturing industries.....	6, 192	7, 330	10, 363	12, 617	15, 125
Heating oils.....	97, 131	115, 533	120, 908	121, 506	112, 581
Fuel oil (No. 1) sold as range oil.....	3, 220	3, 977	4, 449	4, 978	5, 876
Oil company fuel.....	804	1, 064	1, 116	1, 064	884
All other uses.....	10, 728	11, 744	15, 449	25, 556	47, 615
Total United States.....	138, 570	160, 652	173, 339	186, 813	207, 712
Exports and shipments to noncontiguous Territories.....	32, 020	19, 140	16, 925	21, 575	24, 957
Total.....	170, 590	179, 792	190, 264	208, 388	232, 669

¹ Includes Diesel fuel.² Figures for 1944 not yet available.*Sales of residual fuel oil¹ in the United States, 1939-43, by uses²*

[Thousands of barrels]

Use	1939	1940	1941	1942	1943
Railroads.....	60, 977	64, 904	80, 565	99, 996	116, 278
Ships' bunkers (including tankers).....	65, 146	61, 554	56, 678	37, 817	62, 196
Gas and electric power plants.....	27, 908	28, 234	33, 622	28, 101	30, 858
Smelters, mines, and manufacturing industries.....	60, 851	66, 610	78, 024	84, 515	84, 219
Heating oils.....	39, 101	44, 846	46, 606	47, 483	42, 670
Oil company fuel.....	48, 241	50, 864	54, 181	44, 871	47, 123
All other uses.....	16, 149	21, 094	31, 314	62, 550	99, 133
Total United States.....	318, 373	338, 106	380, 990	405, 333	482, 477
Exports and shipments to noncontiguous Territories.....	17, 485	16, 109	14, 114	12, 095	14, 894
Total.....	335, 858	354, 215	395, 104	417, 428	497, 371

¹ Includes Navy grade and crude oil burned as fuel.² Figures for 1944 not yet available.³ This total may involve some duplication due to rehandling of fuel oil initially sold to the Government.

The varying demands for fuel oil by principal uses for the years 1934-43 are presented graphically in figure 10. The lengths of the different columns represent totals for the respective years as reported in the Bureau's annual fuel-oil survey. Distillate fuel oil, residual fuel oil, and kerosine used as range fuel are included.

Exports of fuel oil increased by 44 percent from 39,851,000 barrels in 1943 to 57,172,000 in 1944; however, the expansion was limited to the distillate grades, which rose by 74 percent to a record volume of 43,345,000 barrels in 1944 compared with 24,957,000 in 1943. The foreign market for residual fuel oil has fluctuated narrowly in recent years and declined by 7 percent from 14,894,000 barrels in 1943 to 13,827,000 in 1944. The large increase in distillate fuel-oil exports in 1944 resulted from lend-lease requirements, the United Kingdom receiving 87 percent of the total, or 37,763,000 barrels, in 1944 compared with 16,797,000 in 1943. Canada also was shipped a larger quantity of light fuel oil in 1944—1,714,000 barrels against 423,000 in 1943. Conversely, consignments of distillate grades of fuel oil to Oceania and Australia declined from 4,677,000 barrels in 1943 to 1,197,000 in 1944. Shipments of light fuel oil to U. S. S. R. made another gain, increasing from 264,000 barrels in 1943 to 312,000 in 1944.

Movements of heavy fuel oil to the United Kingdom and to Canada declined greatly in 1944—the quantity credited to the United Kingdom dropping from 10,683,000 barrels in 1943 to 6,058,000 in 1944; and the total for Canada slumped for a second consecutive year from 907,000 barrels in 1943 to 496,000 in 1944. Exports of heavy fuel oil to Mexico, although relatively unimportant, increased from 584,000 barrels in 1943 to 627,000 in 1944. Some residual fuel oil is sent to Cuba, usually for reshipment, and the total in this movement expanded from 680,000 barrels in 1943 to 2,245,000 in 1944.

A 17-percent increase in runs of crude petroleum to stills enabled refiners to produce a record quantity of fuel oil in 1944, when the total of 700,607,000 barrels was 11 percent above the 1943 output of 628,822,000 barrels. The larger production of fuel oil in 1944 was due entirely to the greater volume of crude processed at refineries, as the percentage yield (42.1 percent in 1944 compared with 44.0 percent in 1943) was reduced to increase the output of motor fuel, especially aviation grades. The yield of distillate fuel oil increased from 211,516,000 barrels in 1943 to 239,152,000 in 1944, whereas residual grades expanded from 417,306,000 barrels in 1943 to 461,455,000 in 1944. It should be noted that the production of light fuel oil increased by 13 percent in 1944 compared with an 8-percent increment in 1943, but the 1944 total for heavy fuel oil was only 11 percent over 1943 against a 16-percent gain recorded in 1943.

All refinery districts ran more crude to stills in 1944 than in 1943; therefore, declines in fuel-oil production in 1944 reported for several areas were entirely due to lower percentage yields. The fuel-oil supply situation was critical in the East Coast district in 1944; there the output of light fuel oil was raised by 23 percent (46,763,000 barrels in 1944 compared with 38,077,000 in 1943), in spite of a reduced percentage yield, by running 32 percent more crude to stills. The production of heavy fuel oil in the East Coast increased from 56,004,000 barrels in 1943 to 79,964,000 in 1944—a 43-percent gain. This expanded output of residuals in 1944 was mainly the result of higher runs to stills and an increased percentage yield (31.1 percent in 1944 compared with 28.8 percent in 1943); however, the processing of a larger volume of South American crude of high residual-fuel-oil content was also a factor.

The Texas Gulf Coast refinery district produces more distillate fuel oil than any other area and is second only to California as a

source of residual grades. Distillate fuel oil originating in the Gulf Coast area increased from 64,506,000 barrels in 1943 to 73,935,000 in 1944 and represented about 31 percent of the national total for both years. The 1944 quantity was 15 percent above the 1943 output compared with a 6-percent gain in 1943 over 1942. As the percentage yield for distillate fuel oil dropped in the district (18.1 percent in 1944 compared with 19.3 percent in 1943), the higher production must be credited entirely to a 22-percent gain in runs to stills. Refineries operating in the Texas Gulf Coast turned out 97,683,000 barrels of residual fuel in 1944, a gain of 13 percent over the 1943 production of 86,549,000 barrels. The increase in 1944—as with the distillate grades—was entirely the result of higher crude runs, as the percentage yield declined from 25.8 percent in 1943 to 23.9 percent in 1944.

Sales of fuel oil¹ in the United States, 1939-43, by regions and States²

(Thousands of barrels)

Region and State	1939	1940	1941	1942	1943
Pacific Coast:					
Washington.....	9,193	9,688	12,199	16,029	18,645
Oregon.....	8,752	11,089	12,562	15,577	18,808
California.....	69,790	71,516	77,201	99,839	126,400
Arizona.....	2,220	3,693	4,431	4,819	4,891
Nevada.....	3,109	3,418	4,286	6,067	7,522
Rocky Mountain:					
Idaho.....	453	565	760	1,060	1,036
Montana.....	1,947	2,077	3,220	3,894	4,336
Wyoming.....	1,853	2,012	2,262	2,613	2,890
Utah.....	485	603	692	966	1,374
Colorado.....	890	1,097	1,474	1,794	2,145
New Mexico.....	557	630	701	779	998
North Central:					
North Dakota.....	594	647	677	703	643
South Dakota.....	891	891	909	904	860
Minnesota.....	5,909	6,939	7,309	7,737	7,037
Nebraska.....	2,483	2,721	2,766	2,781	2,688
Iowa.....	2,969	3,449	3,998	4,724	4,744
Wisconsin.....	5,793	6,885	7,344	7,497	7,289
Illinois.....	22,561	26,182	28,943	30,724	30,871
Indiana.....	8,977	9,965	12,782	12,178	12,034
Michigan.....	10,119	11,967	13,584	14,917	14,056
Ohio.....	8,161	9,084	10,970	12,373	13,567
Kentucky.....	1,110	1,355	1,697	2,154	2,273
Tennessee.....	695	1,045	1,263	1,549	2,177
South Central:					
Missouri.....	9,339	10,404	10,948	11,219	11,544
Kansas.....	7,605	8,162	9,277	9,046	12,638
Texas.....	42,012	43,222	51,634	63,449	94,220
Oklahoma.....	8,112	8,444	9,303	9,332	10,377
Arkansas.....	2,156	2,562	3,136	3,511	4,321
Louisiana.....	11,318	11,810	17,151	13,864	17,196
Mississippi.....	631	619	999	812	1,046
Alabama.....	2,127	1,976	2,790	3,313	3,752
New England:					
Maine.....	2,645	3,040	3,892	3,331	2,816
New Hampshire.....	1,812	2,153	2,565	2,043	1,871
Vermont.....	675	803	901	813	633
Massachusetts.....	24,362	26,857	29,996	26,703	22,738
Rhode Island.....	7,893	8,539	9,594	7,535	5,545
Connecticut.....	9,064	10,675	11,358	10,355	9,566
Middle Atlantic:					
New York.....	48,154	54,520	56,790	54,128	56,665
New Jersey.....	48,087	49,578	47,904	47,972	55,128
Pennsylvania.....	27,285	29,206	31,479	31,249	34,740
Delaware.....	1,596	1,717	1,803	1,814	1,964
Maryland.....	10,218	12,286	13,436	13,321	14,649
District of Columbia.....	2,541	2,986	3,456	3,317	2,639
South Atlantic:					
Virginia.....	4,539	4,794	4,462	4,388	7,550
West Virginia.....	1,046	1,128	1,261	1,233	1,635
North Carolina.....	930	1,113	1,364	1,641	1,727
South Carolina.....	1,109	1,252	1,404	1,652	1,494
Georgia.....	2,288	2,418	2,668	2,861	3,402
Florida.....	9,838	10,513	12,445	12,187	13,409
Total United States.....	456,943	498,758	554,329	592,146	690,189

¹ Includes distillate fuel oil, residual fuel oil, and some crude oil burned as fuel.

² Figures for 1944 not yet available.

The 1944 production of distillate fuel oil in the Indiana-Illinois refinery district—34,544,000 barrels—varied little from the 1943 quantity of 34,631,000 barrels. A 5-percent reduction in the output of heavy fuel oil in this district (56,890,000 barrels in 1944 compared with 59,621,000 in 1943) forced the area down from third to fourth as a producing district, and the East Coast moved up.

More heavy fuel oil—30 percent of the national total—is produced in California than in any other refinery district, and it ranks fourth as a source of distillate grades. The output of distillate fuel oil in California in 1944—29,382,000 barrels—was only 2 percent above the 1943 quantity of 28,881,000 barrels, and compares with an 18-percent expansion realized in 1943. The smaller percentage gain in 1944 resulted largely from a decline in the yield from 10.9 percent in 1943 to 10.0 in 1944. Refiners operating in California produced 135,946,000 barrels of residual fuel oil in 1944 compared with 126,856,000 in 1943. The smaller rate of gain (7 percent) for heavy fuel oils in 1944 compared with a 22-percent increase in 1943 was almost entirely, as with the light grades, connected with a lower yield, 46.1 percent in 1944 against 48.1 percent in 1943.

Gains and losses in fuel-oil production in 1944 for refinery districts where the volumes are relatively unimportant were as follows: Appalachian, distillate fuel oil 2 percent below and residual fuel oil 11 percent below the 1943 quantity; Oklahoma-Kansas, light fuel oil 13 percent higher and heavy grades 4 percent less than the 1943 output; Texas Inland, distillate 13 percent and residual 5 percent over the 1943 total; Louisiana Gulf Coast, a 64-percent gain in light fuel oil production and a 28-percent expansion for residual grades over 1943; Arkansas and Louisiana Inland, a 7-percent loss for distillate fuel oils and a 12-percent decline for heavy fuel oil; and the Rocky Mountain district, an 18-percent gain for light grades and a 10-percent rise in the output of residual fuel oil over the 1943 volume. The high rate of gain shown for distillate fuel oil in the Louisiana Gulf area was the result of a 48-percent rise in runs to stills as well as to an increase in yield from 16.6 percent in 1943 to 18.4 percent in 1944. The percentage yield for residuals dropped in 1944, so the larger output for the heavier grades in this district must be credited to the increased volume of crude processed in 1944.

Some crudes, either low in gasoline content or on location in field operations, are used direct as fuel without any refining. Such crudes are recognized as an added supply of fuel oil and are termed "transfers" in fuel-oil accounting. During the war period and the resulting pinch for fuel oil, transfers have doubled from 15,482,000 barrels in 1941 to 31,757,000 in 1944, and furthermore, the 1944 total is 17 percent above the quantity reported in 1943—27,157,000 barrels.

Heavy crude oil consumed as fuel on oil leases or in industrial plants is covered in transfers to the residual fuel-oil account, and light crudes used in some areas as fuel in the operation of pipe lines are added to distillate fuel oils. Transfers of high-gravity or light crudes increased from 3,070,000 barrels in 1943 to 3,242,000 in 1944—a 6-percent gain, whereas heavy or low-gravity crudes used as fuel expanded by 18 percent, from 24,087,000 barrels in 1943 to 28,515,000 in 1944. Most of the light crudes are consumed as fuel in areas east of California, where the total of 3,163,000 barrels for 1944 differed little from the 1943 quantity of 3,051,000 barrels. Very little light crude is burned

as fuel in California—only 19,000 barrels in 1943 and 79,000 in 1944. The larger share of the heavy crude reported under "transfers" is credited to California, the volume increasing by 23 percent, from 18,861,000 barrels in 1943 to 23,177,000 in 1944. Transfers of heavy crude to the fuel-oil account for areas east of California totaled 5,226,000 barrels in 1943 and 5,338,000 in 1944.

Imports of fuel oil, greatly depressed in 1942 because of enemy submarine activities and the lack of tankers for civilian use, rebounded to a normal level in 1943 and continued to expand nominally in 1944, when total receipts of fuel oil from foreign sources of 43,649,000 barrels were 3 percent over 1943 imports of 42,479,000 barrels. The supply of residual fuel oil was critical in the Atlantic Coast area in 1944; consequently, an effort was made to bring in stocks from foreign sources, with the result that the total of 36,553,000 barrels approached the prewar level of 1941 (37,369,000 barrels) and exceeded 1943 receipts of 27,210,000 barrels by 34 percent. Imports of distillate fuel oil (7,096,000 barrels in 1944) were 54 percent below the unusually high total of 15,269,000 recorded for 1943; however, the deflated 1944 quantity for distillate grades was still well above prewar receipts from foreign sources.

Imported fuel oil supplies a very small proportion of the total domestic and export demand. Distillate fuel oil of foreign origin satisfied 2 percent of the total market in 1942, then with the record receipts in 1943, the share rose to 7 percent; however, it declined to 3 percent of the total in 1944, when imports were lower by over 50 percent. The volume of residual fuel oil received from abroad has expanded noticeably in recent years, and the share of the total market it has supplied has mounted from 4 percent in 1942 to 6 percent in 1943 and to 7 percent in 1944.

Practically all the fuel oil imported into this country is credited to the West Indian island of Curaçao, where petroleum refineries, running on Venezuelan crude, are located. Some small quantities are also received from Venezuela, Trinidad, Mexico, and Canada.

The fuel-oil stock situation showed great improvement in 1944, even though oil companies were called upon to supply record domestic and export demands. Liquidations of fuel-oil stocks totaling approximately 25,500,000 barrels necessary in 1942 and 16,500,000 in 1943 were not repeated in 1944, when the year-end total of 88,716,000 barrels was only about 1,500,000 below the comparative inventory for 1943 of 90,212,000 barrels. The small shrinkage in 1944 was a net loss, as stocks of distillate grades declined by 8 percent from 41,728,000 barrels for 1943 to 38,333,000 at the end of 1944, while the heavy fuel-oil inventory increased by about 4 percent from 48,484,000 barrels for 1943 to 50,383,000 as of December 31, 1944. The percentage loss for distillate stocks in 1944 (8 percent) differed little from comparative rates of liquidation of 7 percent for 1943 and 9 percent for 1942; however, the percentage gain for residuals in 1944 (4 percent) is in contrast to percentage declines of 22 percent in 1943 and 26 percent in 1942. Both refinery and bulk-terminal inventories of distillate fuel oil dropped in 1944, but comparative items for heavy fuel oil were higher in 1944 than in 1943. Light grades of fuel held at refineries shrunk by 10 percent from 27,816,000 barrels for 1943 to 25,070,000 at the 1944 year end. The loss in bulk-terminal storage of distillates was less marked—a 5-percent decline—or from 13,912,000

Comparative analyses of statistics for distillate fuel oil in the United States, 1943-44, by months and districts
[Thousands of barrels]

Month and district	Production		Yield (percent)		Transfers ¹		Imports		Exports		Domestic demand		Stocks	
					California									
	1943	1944 ²	1943	1944 ²	East of Calif- ornia	1943	1944 ²	1943	1944 ²	1943	1944 ²	1943	1944 ²	
By months:														
January.....	17,306	19,344	15.5	14.5	224	265	179	1,322	1,508	1,677	22,127	24,108	39,014	36,890
February.....	16,240	18,454	15.9	14.5	213	263	432	600	1,456	2,386	19,145	20,294	35,298	33,561
March.....	17,288	19,863	15.4	14.4	229	275	166	798	1,863	2,325	19,983	22,248	31,135	29,926
April.....	16,690	19,604	14.9	14.8	290	259	612	599	2,426	4,109	15,627	16,131	30,674	30,152
May.....	16,075	21,215	14.0	15.2	247	237	499	853	2,363	4,215	14,470	15,780	30,665	32,484
June.....	15,261	20,028	13.2	14.3	242	246	7	4,285	447	2,358	15,628	12,473	32,467	35,242
July.....	16,073	21,316	13.3	14.9	265	266	7	2,174	468	3,478	13,177	13,566	34,324	38,335
August.....	18,210	20,593	14.3	14.4	253	262	5	3,523	392	2,854	16,525	13,171	36,931	40,712
September.....	18,523	19,110	14.7	13.6	261	265	5	978	199	1,912	15,100	12,687	39,081	43,087
October.....	20,549	21,697	15.9	15.1	279	270	1	949	228	1,820	14,781	14,827	44,857	47,352
November.....	19,370	18,870	15.3	13.5	269	264	16	1,441	209	1,365	19,482	19,010	44,806	45,584
December.....	19,931	19,058	15.1	13.1	279	271	331	781	1,554	2,086	22,065	25,275	41,728	38,333
Total United States.....	211,516	239,152	14.8	14.4	3,051	3,163	19	15,269	7,096	43,345	208,110	209,540	41,728	38,333
By districts:														
East Coast.....	38,077	46,763	19.6	18.2									12,293	9,621
Appalachian.....	6,460	6,313	11.8	11.2									1,074	734
Indiana, Illinois, Kentucky, etc.....	34,631	34,544	13.1	12.4	621	559							5,873	6,419
Oklahoma, Kansas, and Missouri.....	17,099	19,281	13.8	14.5	962	928							1,795	2,132
Texas Inland.....	4,701	5,303	6.4	6.4	770	917							375	374
Texas Gulf Coast.....	64,506	73,935	19.3	18.1	352	375							7,452	7,549
Louisiana Gulf Coast.....	9,477	15,572	16.6	18.4	124	131							1,306	1,292
Louisiana and Louisiana Inland.....	4,017	3,726	14.8	13.3	40	43							524	597
Arkansas and Louisiana Inland.....	3,687	4,333	10.4	10.5	182	210							362	356
Rocky Mountain.....	28,881	29,382	10.9	10.0			19	79					10,674	9,259
California.....														
Total United States.....	211,516	239,152	14.8	14.4	3,051	3,163	19	15,269	7,096	43,345	208,110	209,540	41,728	38,333

¹ Figures represent crude oil used as fuel on pipe lines.

² Subject to revision.

³ Figures not available.

barrels in 1943 to 13,263,000 in 1944. Oil companies held 40,356,000 barrels of residual fuel oil at their refineries in December 1944 compared with 38,855,000 for 1943 (a 4 percent rise), and supplies at bulk terminals made a similar percentage gain from 9,629,000 barrels in 1943 to 10,027,000 at the close of 1944.

Distillate fuel oil withdrawn from storage supplied a little over 1 percent of the total domestic and export market in 1943 and 1944, whereas heavy fuel oil diverted from stocks satisfied about 3 percent of the marketed quantity in 1943 and no proportion of it in 1944. Distillates held in storage at the end of 1944 were sufficient for 47 days of domestic supply at the December rate of demand in contrast to a 59-day reserve on hand at the close of 1943. The comparative days of supply for residuals dropped from 33 for 1943 to 31 for 1944.

The larger share of distillate fuel-oil stocks is held in the East Coast, although the proportion declined from 30 percent of the national total in 1943 to 25 percent at the close of 1944. Quantitatively the East Coast inventory for light fuel oils dropped by 22 percent from 12,293,000 barrels in 1943 to 9,621,000 in 1944. The slump in East Coast distillate stocks in 1944 is in contrast to a 46-percent gain reported for 1943 over an unusually low reserve held at the end of 1942. Residual fuel oils stored in the Atlantic Coast area are less important nationally; however, the total has been built up from 3,613,000 barrels for the critical war year of 1942 to 6,341,000 in 1943 and to 6,831,000 in December 1944.

More residual fuel oil is held in the California area than in any other part of the country, but under the pressure of war demands the quantity dropped drastically (by 40 percent) in 1943 and to a lesser extent (by 2 percent) in 1944. Stocks of heavy fuel oil in California declined from 26,608,000 barrels (55 percent of the national total) for 1943 to 26,047,000 (52 percent of the national total) at the close of 1944. Considerable quantities of distillate fuel oil are also stored on the west coast, although the total has declined from 12,185,000 barrels in 1942 to 10,674,000 in 1943 and to 9,259,000 in 1944.

Light fuel oil held in storage in the Texas Gulf refinery district reached a high level in 1942 (12,336,000 barrels), as this fuel could not be moved to East Coast consuming areas under prevailing transportation difficulties. Traffic conditions were partly remedied in 1943 and 1944, so that there was a more normal flow of supplies to eastern markets, and consequently stocks of distillate fuel oil in the Texas Gulf area dropped to 7,452,000 barrels in 1943 and rose only nominally to 7,549,000 by the end of 1944. Rising production of residual fuel oil in the Texas Gulf Coast has made it possible for year-end inventories in the district to increase from 6,275,000 barrels in 1942 to 8,136,000 in 1943 and to 9,974,000 in 1944.

Fairly important stocks of distillate fuel oil are carried in the Indiana-Illinois refinery district, and inventories there have increased in recent years to 6,419,000 barrels at the close of 1944—a 9-percent expansion over the comparative total for 1943 of 5,873,000 barrels. Holdings of residual grades of fuel oil in the same area have also shown small gains rising to 3,060,000 barrels at the end of 1944 against 2,983,000 for 1943; however, the 1944 volume is still well below prewar quantities.

Comparative analyses of statistics for residual fuel oil in the United States, 1943-44, by months and districts
[Thousands of barrels]

Month and district	Production		Yield (percent)		Transfers ¹		Imports		Exports		Domestic demand		Stocks	
	1943	1944 :	1943	1944 :	East of California	California	1943	1944 :	1943	1944 :	1943	1944 :	1943	1944 :
By months:														
January.....	32,544	38,519	29.2	28.9	351	518	1,999	2,537	1,138	549	34,998	45,763	90,808	46,270
February.....	30,769	36,468	29.2	28.7	344	490	1,364	1,669	934	1,078	34,212	41,607	59,657	45,477
March.....	37,700	39,738	29.2	28.8	384	460	1,530	2,012	1,460	841	36,277	43,667	57,280	44,137
April.....	34,095	37,281	30.5	28.2	422	420	1,415	1,973	1,640	841	35,965	43,670	57,381	44,682
May.....	33,732	37,024	29.3	27.3	395	419	1,428	1,881	1,818	1,873	37,137	41,913	57,757	46,649
June.....	33,510	37,902	28.9	27.1	420	389	1,205	1,894	1,818	1,902	40,256	39,683	56,879	46,049
July.....	36,624	38,332	30.3	28.7	433	384	1,135	1,686	2,474	1,422	37,495	38,612	57,107	50,889
August.....	37,418	37,291	29.5	28.1	503	434	1,686	1,666	1,582	1,812	42,533	38,012	56,837	53,506
September.....	36,610	37,903	29.0	27.0	404	426	1,759	1,720	1,609	886	41,109	43,796	57,977	57,849
October.....	34,683	36,322	26.9	27.4	478	478	1,839	2,179	1,536	886	41,109	43,796	57,977	57,490
November.....	36,649	39,370	29.0	28.1	508	440	2,037	2,024	1,199	1,873	42,426	44,425	53,046	55,643
December.....	37,963	41,278	28.8	28.4	485	470	1,764	1,973	836	1,901	45,915	50,327	48,484	50,383
Total United States.....	417,306	461,455	29.2	27.7	5,226	5,338	18,861	23,177	14,894	13,827	467,008	510,797	48,484	50,383
By districts:														
East Coast.....	58,004	79,964	28.8	31.1	678	614	1,999	2,537	1,138	549	34,998	45,763	90,808	46,270
Appalachian.....	10,274	9,194	18.7	16.3	678	614	1,999	2,537	1,138	549	34,998	45,763	90,808	46,270
Indiana, Illinois, Kentucky, etc.....	58,621	56,890	22.5	20.4	678	614	1,999	2,537	1,138	549	34,998	45,763	90,808	46,270
Oklahoma, Kansas, and Missouri.....	28,969	23,984	20.1	18.0	240	310	1,135	1,686	1,582	1,812	42,533	38,012	56,837	53,506
Texas Inland.....	22,742	23,792	31.2	26.8	1,120	759	1,759	1,720	1,609	886	41,109	43,796	57,977	57,849
Texas Gulf Coast.....	22,742	23,792	25.8	23.9	1,029	685	1,759	1,720	1,609	886	41,109	43,796	57,977	57,849
Louisiana Gulf Coast.....	12,768	16,322	22.3	19.3	1,161	1,010	1,759	1,720	1,609	886	41,109	43,796	57,977	57,849
Louisiana and Louisiana Inland.....	7,294	6,447	26.9	23.0	664	759	1,759	1,720	1,609	886	41,109	43,796	57,977	57,849
Rocky Mountain.....	10,229	11,233	26.9	27.2	664	759	1,759	1,720	1,609	886	41,109	43,796	57,977	57,849
California.....	126,856	135,946	48.1	46.1	695	690	1,999	2,537	1,138	549	34,998	45,763	90,808	46,270
Total United States.....	417,306	461,455	29.2	27.7	5,226	5,338	18,861	23,177	14,894	13,827	467,008	510,797	48,484	50,383

¹ Represents quantities used on leases and for general industrial purposes.

² Subject to revision.

³ Figures not available.

Stocks of fuel oil credited to other refinery districts are relatively unimportant. Percentage gains and losses in 1944 year-end inventories over 1943 for distillate fuel oil in these remaining areas were as follows: Oklahoma-Kansas, 19 percent up; Arkansas and Louisiana Inland, 14 percent up; Appalachian, 32 percent down; Texas Inland, less than 1 percent down; Louisiana Gulf, 1 percent down; and Rocky Mountain, 2 percent down. Similar percentage stock changes for heavy fuel oils in 1944 were: Appalachian, 85 percent up; Oklahoma-Kansas, 35 percent up; Texas Inland, 3 percent down; Louisiana Gulf, 19 percent down; Arkansas and Louisiana Inland 29 percent down; and Rocky Mountain, 30 percent down.

Tanker movements of fuel oil from California to eastern areas of the country have not been reported for several years, and there was no revival of this trade in 1944. The California refinery district (California, Oregon, Washington, Arizona, and Nevada), however, ships some minor quantities of fuel oil by railroads and trucks to neighboring Western States. Distillate fuel oils distributed over these land routes increased from 435,000 barrels in 1943 to 492,000 in 1944, while the volume of residual grades declined from 215,000 barrels in 1943 to 182,000 in 1944. There is also a compensating movement of small amounts of fuel oil into the California marketing area from other States, and this traffic expanded noticeably in 1944 as the war in the Pacific became accelerated. Domestic fuel oils shipped into the California refinery district totaled 275,000 barrels of distillates in 1944 against 19,000 in 1943 and 571,000 barrels of residual types in 1944 compared with 322,000 in 1943.

Movement of domestic fuel oils into the East Coast (district 1) by tanker, barge, rail, and pipe line, 1943-44

[Thousands of barrels]

	Distillate fuel oil		Residual fuel oil	
	1943	1944	1943	1944
Tanker—Gulf Coast to East Coast.....	14,881	10,980	12,996	18,300
Railroads—district 2 to East Coast.....	12,775	10,614	9,125	8,418
Railroads—district 3 to East Coast.....	36,135	18,300	48,910	43,554
Barge—Gulf Coast to Mississippi-Ohio River points.....	1,825	366	365	366
Barge—Ohio River system to Northeast States.....	365	366	1,095	1,464
Tanker and barge—Great Lakes to East Coast.....	730	366	2,190	1,830
Barge—Gulf Coast to Florida West Coast.....	730	2,196	365	366
Pipe line to East Coast.....		18,300		
Total.....	67,441	61,488	75,046	74,298

Source: Petroleum Industry War Council and Petroleum Administration for War.

In normal times considerable quantities of fuel oil are moved by tanker from Gulf Coast ports to East Coast markets. This waterborne traffic has dwindled during the present emergency, and consequently other means of transportation—tank cars, barges and pipe lines—have been used instead. Records compiled by the Petroleum Industry War Council and the Petroleum Administration for War show that the volume of this flow of fuel oil from districts 2 and 3 into the East Coast (district 1) increased somewhat in 1943 over 1942, although there was a decline in 1944 compared with 1943. Light fuel oils in this movement declined by 9 percent from 67,441,000 barrels in 1943 to 61,488,000 in 1944, while the volume of residual grades

dropped by one percent from 75,046,000 barrels in 1943 to 74,298,000 in 1944. The quantity of distillate fuel oil moved by tankers from the Gulf Coast to the Atlantic seaboard continued to decline from 20,341,000 barrels in 1942 to 14,881,000 in 1943 and to 10,980,000 in 1944. The total for residual grades slumped from 27,149,000 barrels in 1942 to 12,996,000 in 1943; however, it increased to 18,300,000 in 1944. The tank-car movement of light fuel oil into the East Coast marketing area declined from 48,910,000 barrels in 1943 to 28,914,000 in 1944, but this loss was largely made up by pipe-line receipts of 18,300,000 barrels in 1944 against none moved by that method in 1943. The railroads hauled 58,035,000 barrels of heavy fuel oil to the East Coast in 1943 and only 51,972,000 in 1944. Some relatively unimportant quantities of fuel oil were shipped to the East Coast area in barges and small tankers operating in coastal and inland waters. The detailed items for all these movements of fuel oil from districts 2 and 3 into district 1 are given in the accompanying table.

There were no changes in tanker rates in 1944 on fuel oil shipped from the Gulf Coast to North Atlantic ports, not east of New York. Charges of 42 cents a barrel for No. 2 fuel oil and 48 cents for crude and residual oils (10°-19.9° gravity) dating from January 1942 were continued throughout 1944. A surcharge of 200 percent allowed by the War Shipping Administration to cover increased wartime expenses, initiated in April 1942, was still in effect during 1944.

Monthly average prices of kerosine and fuel oils in the United States, 1943-44¹

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1943													
41°-43° gravity w. w. kerosine at refineries, Oklahoma.....	4.44	4.44	4.44	4.44	4.44	4.44	4.44	4.44	4.39	4.38	4.38	4.38	4.42
cents per gallon.....													
Kerosine, tank-wagon at Chicago.....	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60
cents per gallon.....													
No. 2 straw fuel oil at refineries, Oklahoma.....	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63
cents per gallon.....													
Bunker C for ships:													
New York.....													
dollars per barrel.....	1.65	1.65	1.81	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.82
Gulf coast.....do.....	(²)	.85	.98	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.03
California.....do.....	.84	.84	.85	.85	.85	1.05	1.10	1.10	1.10	1.10	1.10	1.10	.98
Diesel oil for ships:													
New York.....	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78
do.....do.....	(²)	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
Gulf coast.....do.....	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43
California.....do.....													
1944													
41°-43° gravity w. w. kerosine at refineries, Oklahoma.....	4.38	4.38	4.38	4.38	4.38	4.38	4.38	4.38	4.38	4.38	4.38	4.38	4.38
cents per gallon.....													
Kerosine, tank-wagon at Chicago.....	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60
cents per gallon.....													
No. 2 straw fuel oil at refineries, Oklahoma.....	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63
cents per gallon.....													
Bunker C for ships:													
New York.....													
dollars per barrel.....	1.86	1.86	1.86	1.86	1.86	1.86	1.77	1.77	1.77	1.77	1.77	1.77	1.82
Gulf coast.....do.....	1.06	1.06	1.06	1.06	1.06	1.06	.97	.97	.97	.97	.97	.97	1.02
California.....do.....	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Diesel oil for ships:													
New York.....	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78
do.....do.....	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
Gulf coast.....do.....	1.42	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45
California.....do.....													

¹ Platt's Oil Price Handbook.

² No quotations posted.

The price of representative fuel oils in 1944 remained at 1943 levels except for some changes announced for residual grades including Bunker C in the Atlantic and Gulf Coast areas and for ships' Diesel fuel in California. During the period March 9, 1943, to August 1, 1944, quotations for Bunker C (and other heavy fuel oils) were based on the gravity and for New York harbor ranged from \$1.65 to \$2.07 a barrel (\$1.86 average), and for Gulf Coast ports they varied from 85 cents to \$1.27 or an average of \$1.06 a barrel. Amendment 13 to price schedule MPR 88 of the Office of Price Administration, effective August 1, 1944, changed the quotations for heavy fuel oil from the former range based on varying gravities to a fixed price irrespective of the gravity. The new price for Bunker C at New York was placed at \$1.77 a barrel and at 97 cents a barrel at Gulf ports. Quotations on Bunker C at California terminals of \$1.10 a barrel dating from June 1943 remained in force all during 1944.

The quoted price on Diesel fuel for ships' bunkers at New York harbor—\$2.78 a barrel—in force since September 1942 held throughout 1944, and the price for the same grade at Gulf ports—\$1.65 a barrel—effective since December 1942, was also unchanged in 1944. The California price of Diesel fuel for ships averaging \$1.43 a barrel, dating from May 1943, was raised to a fixed quotation of \$1.45 a barrel on January 21, 1944, and this value was maintained for the rest of the year.

The price of No. 2 straw fuel oil at refineries in Oklahoma was pegged at 3.63 cents a gallon in December 1942, and this quotation remained in force during all of 1943 and 1944.

Average retail prices of fuel oil were fairly stable in 1944, as indicated by monthly quotations compiled for a number of cities and published by the Bureau of Labor Statistics, United States Department of Labor. The consumers average price for No. 2 fuel oil at Chicago of 7.96 cents a gallon in force since December 1942 remained unchanged until August 1944 when it declined to 7.76 cents a gallon and then to 7.45 cents in September, where it remained until the end of the year. The declines were merely market fluctuations, as no changes were ordered by the Office of Price Administration at the time. A retail quotation for No. 2 in New York City of 9.09 cents a gallon, going back to December 1942, was held at the same level for all of 1943 and 1944.

LUBRICATING OIL

The demand for lubricating oil totaled 40,322,000 barrels in 1943 and rose to 41,072,000 barrels in 1944. Exports of 8,889,000 barrels in 1944 were approximately the same as in 1943, but almost 2 million barrels below the prewar level.

The domestic demand for lubricating oil rose from 31,459,000 barrels in 1943 to 32,183,000 barrels in 1944, exceeding the demand in 1941 by about 2 million barrels. The sharp decline in civilian automotive use has been offset by the increased demand for industrial lubricants and the expansion in aviation and military transport requirements.

The yield of lubricating oil from crude declined from 2.9 percent in 1942 to 2.7 percent in 1943 and 2.5 percent in 1944. This decline in yield reflects the fact that total production has increased less rapidly than total crude runs to stills.

Refinery stocks of lubricating oil, after a decline of 1.6 million barrels in 1943, showed a minor gain in 1944 and amounted to 7,815,000 barrels at the end of the year.

The refinery production of lubricating oil rose to 41,106,000 barrels in 1944. Since 1941 the most notable changes in the production of lubricating oil by districts have been the decline in the Appalachian area and substantial increases in the Texas Gulf Coast, Oklahoma, Kansas, Arkansas and Louisiana Inland, and California districts. Production in the Appalachian district declined from 5,652,000 barrels in 1943 to 5,278,000 in 1944. Production in the East Coast district rose from 7,205,000 barrels in 1943 to 8,237,000 barrels in 1944 but was still below the level of 1941. In the Texas Gulf Coast, production increased from 9,745,000 barrels in 1943 to 10,614,000 barrels in 1944.

Comparative analyses of statistics for lubricating oil in the United States, 1943-44, by months and districts

Month and district	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks (thousands of barrels)	
	1943	1944 ¹	1943	1944 ¹	1943	1944 ¹	1943	1944 ¹
By months:								
January.....	2,935	3,379	2.6	2.5	1,901	2,553	9,725	8,006
February.....	2,780	3,158	2.7	2.5	2,156	2,567	9,771	7,942
March.....	3,184	3,488	2.8	2.5	2,675	2,687	9,689	8,011
April.....	3,107	3,273	2.8	2.5	2,758	2,564	9,474	8,068
May.....	3,281	3,337	2.8	2.4	2,824	2,628	9,155	7,771
June.....	3,162	3,453	2.7	2.5	2,798	2,751	8,695	7,560
July.....	3,257	3,364	2.7	2.3	2,540	2,611	8,412	7,426
August.....	3,296	3,356	2.6	2.4	2,945	2,734	8,170	7,169
September.....	3,236	3,458	2.6	2.4	2,756	2,551	7,531	7,364
October.....	3,635	3,672	2.8	2.5	2,804	2,836	7,712	7,452
November.....	3,589	3,587	2.8	2.6	2,532	3,027	7,770	7,562
December.....	3,217	3,581	2.4	2.5	2,460	2,674	7,781	7,815
Total United States.....	38,679	41,106	2.7	2.5	31,459	32,183	7,781	7,815
By districts:								
East Coast.....	7,205	8,237	3.7	3.2			2,136	2,428
Appalachian.....	5,652	5,278	10.3	9.4			646	605
Indiana, Illinois, Kentucky, etc.	4,689	4,526	1.8	1.6			941	830
Oklahoma, Kansas, and Missouri.....	4,451	4,627	3.6	3.5			641	494
Texas Inland.....	244	208	3	3			39	23
Texas Gulf Coast.....	9,745	10,614	2.9	2.6	(¹)	(¹)	1,647	1,736
Louisiana Gulf Coast.....	1,945	2,157	3.4	2.6			186	153
Arkansas and Louisiana Inland.....	1,153	1,438	4.3	5.1			79	125
Rocky Mountain.....	251	256	4	6			94	88
California.....	3,344	3,765	1.3	1.3			1,392	1,333
Total United States.....	38,679	41,106	2.7	2.5	31,459	32,183	7,781	7,815

¹ Subject to revision.

² Figures not available.

Domestic demand for lubricating oil, 1940-44

(Thousands of barrels)

Year	Automotive				Industrial ¹	Total demand
	Passenger cars	Trucks	Busses	Total		
1940.....	8,071	2,636	223	10,930	13,760	24,690
1941.....	8,715	2,722	242	11,679	18,576	30,255
1942.....	5,916	2,435	279	8,630	20,427	29,057
1943.....	4,204	2,250	289	6,743	24,716	31,459
1944.....	(²)	(²)	(²)	(²)	(²)	² 32,183

¹ Includes military.

² Not available.

³ Subject to revision.

*Automotive consumption of lubricants in the United States, 1942-43*¹

[Thousands of barrels]

Use	Passenger cars		Trucks		Busses	
	1942	1943	1942	1943	1942	1943
Crankcase oil.....	5,424	3,837	2,203	2,031	235	243
Transmission oils.....	492	367	232	219	44	46
Total lubricating oils.....	5,916	4,204	2,435	2,250	279	289
Chassis greases.....	443	330	116	109	12	13
Total lubricants.....	6,359	4,534	2,551	2,359	291	302

¹ Not available for 1944.*Average monthly refinery prices of five selected grades of lubricating oil in the United States, 1943-44, in cents per gallon*¹

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1943													
Oklahoma:													
200 viscosity, No. 3 color, neutral.....	15.00	15.00	15.00	15.00	15.00	15.60	15.00	15.00	15.00	15.00	15.00	15.00	15.00
150-160 viscosity at 210°, bright stock, 10-25 pour test.....	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75
Pennsylvania:													
200 viscosity, No. 3 color, neutral, 420-425 flash, 25 pour test.....	24.50	24.50	24.50	24.50	24.50	25.52	26.50	26.50	26.50	27.21	28.82	29.95	26.13
600 steam-refined, cylinder stock, filterable.....	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Gulf Coast: 500 viscosity, No. 2½-3½ color, neutral.....	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
1944													
Oklahoma:													
200 viscosity, No. 3 color, neutral.....	15.00	15.00	15.00	15.00	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	14.00
150-160 viscosity at 210°, bright stock, 10-25 pour test.....	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75
Pennsylvania:													
200 viscosity, No. 3 color, neutral, 420-425 flash, 25 pour test.....	30.25	30.25	30.25	30.38	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.43
600 steam-refined, cylinder stock, filterable.....	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Gulf Coast: 500 viscosity, No. 2½-3½ color, neutral.....	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

¹ National Petroleum News.**OTHER PRODUCTS**

Wax.—The total demand for wax increased from 700 million pounds in 1942 to 759 million in 1943 and 796 million in 1944. Imports have declined since 1940 and ceased in 1944.

The domestic demand for wax has exceeded all previous levels owing to war uses in the protection and weather-proofing of materials shipped abroad. Domestic demand, including all of our military requirements at home and abroad, has risen from 357 million pounds in 1940 to 634 million in 1944—a gain of 277 million pounds or 80 percent.

Exports of wax amounted to 173 million pounds in 1943 and 162 million in 1944. The largest exports in 1944 were 64 million pounds to the United Kingdom, 19 million to Canada, and 13 million to Colombia.

The East Coast refinery district produced almost 36 percent of the output of wax in 1944. The principal changes in production, by districts, in 1944 compared with 1943 were gains of 42 million pounds in the East Coast, 12 million in California, and 6 million in the Louisiana Gulf Coast and Oklahoma-Kansas districts. The principal decline was 14 million pounds in the Texas Gulf Coast.

Comparative analyses of statistics for wax in the United States, 1943-44, by months and districts

[Thousands of pounds]

Month and district	Production		Domestic demand		Exports		Stocks	
	1943	1944 ¹	1943	1944 ¹	1943	1944 ¹	1943	1944 ¹
By months:								
January.....	57,680	71,120	44,847	62,459	14,233	10,061	84,000	80,640
February.....	54,900	58,800	45,875	54,923	11,245	11,437	81,480	80,080
March.....	65,240	79,800	45,763	58,487	19,517	16,883	88,440	84,560
April.....	66,920	76,440	49,311	54,753	16,769	12,167	84,280	94,080
May.....	63,840	65,520	48,879	49,847	13,561	15,963	85,680	93,800
June.....	60,480	60,480	42,478	51,638	22,202	11,082	71,480	91,560
July.....	59,320	63,560	49,963	45,903	14,687	15,417	78,720	83,800
August.....	61,320	64,120	49,342	47,866	15,164	14,014	73,640	96,040
September.....	62,160	62,160	45,933	51,926	12,307	11,354	77,580	94,920
October.....	67,200	67,480	54,336	50,442	8,944	15,078	81,480	96,880
November.....	66,600	63,560	57,180	49,674	11,703	15,846	81,200	94,920
December.....	67,200	67,200	53,893	55,685	12,467	12,635	82,040	93,800
Total United States.....	755,160	807,240	585,630	633,603	172,799	161,877	82,040	93,800
By districts:								
East Coast.....	246,680	286,720					25,480	27,160
Appalachian.....	101,080	102,480					15,400	17,360
Indiana, Illinois, Kentucky, etc.....	64,680	62,160					16,800	15,960
Oklahoma, Kansas, and Missouri.....	78,680	84,840					6,720	5,320
Texas Inland.....	3,080	2,520	(?)	(?)	(?)	(?)	280	280
Texas Gulf Coast.....	143,080	129,080					9,800	10,640
Louisiana Gulf Coast.....	93,520	99,680					840	1,680
Rocky Mountain.....	21,000	24,640					6,730	14,000
California.....	3,360	15,120					.....	1,400
Total United States.....	755,160	807,240	585,630	633,603	172,799	161,877	82,040	93,800

¹ Subject to revision.

² Figures not available.

Average monthly refinery price of 122°-124° white crude scale wax at Pennsylvania refineries, 1940-44, in cents per pound¹

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1940.....	6.21	5.57	5.32	4.79	4.69	4.19	2.93	2.21	2.51	2.81	2.93	2.87	3.92
1941.....	2.73	2.63	2.86	3.28	3.85	4.96	5.13	5.26	5.96	6.26	6.21	4.26	4.45
1942.....	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26
1943.....	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26
1944.....	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26	4.26

¹ National Petroleum News.

Coke.—The production of petroleum coke rose from 1,388,000 short tons in 1943 to 1,803,000 tons in 1944 or 30 percent. A withdrawal of 71,000 tons from storage raised total demand to 1,874,000 tons in 1944. Exports declined from 314,000 tons in 1943 to 209,000 tons in 1944, and domestic demand increased from 1,050,000 tons in

1943 to 1,665,000 in 1944. Both production and consumption in 1944 exceeded the prewar level.

Normally, a substantial amount of petroleum coke was consumed for domestic heating purposes, but most of the supply was reserved for electrode manufacture to meet war requirements, particularly in the aluminum industry. These restrictions were partly removed in 1944, and some coke was released for heating purposes.

The principal refinery districts producing petroleum coke, in order of their importance in 1944, were the Indiana-Illinois, Texas Gulf Coast, Louisiana Gulf Coast, Oklahoma-Kansas, Texas Inland, and California districts. The Indiana-Illinois district produced 61 percent of the total in 1943 and 62 percent in 1944.

Comparative analyses of statistics for petroleum coke in the United States, 1943-44, by months and districts

Month and district	Production (thousands of short tons)		Yield (percent)		Domestic demand (thousands of short tons)		Stocks (thous- ands of short tons)	
	1943	1944 ¹	1943	1944 ¹	1943	1944 ¹	1943	1944 ¹
By months:								
January.....	113.0	116.2	0.5	0.4	61.2	174.0	273.2	179.4
February.....	93.4	137.6	.5	.5	77.6	130.3	276.4	105.6
March.....	98.0	143.6	.4	.5	56.6	117.6	294.2	172.8
April.....	102.2	137.0	.5	.5	56.8	122.4	310.0	106.4
May.....	105.0	144.8	.4	.5	62.4	148.8	314.8	141.4
June.....	115.2	135.4	.5	.5	77.6	136.4	324.6	127.2
July.....	113.0	167.8	.5	.6	65.4	144.4	339.8	129.6
August.....	121.6	168.2	.5	.6	79.2	142.8	365.0	115.8
September.....	133.8	154.4	.5	.6	106.4	134.8	357.0	116.0
October.....	131.2	181.2	.5	.6	99.4	145.8	354.8	137.2
November.....	124.4	163.8	.5	.6	125.0	133.6	325.0	161.6
December.....	125.6	172.4	.5	.6	172.4	144.0	258.2	187.2
Total United States.....	1,388.4	1,803.4	.5	.5	1,050.0	1,665.5	268.2	187.2
By districts:								
East Coast.....	2.6	2.2	(²)	(²)			2.0	1.0
Appalachian.....	22.2	24.8	.2	.2			5.6	2.4
Indiana, Illinois, Kentucky, etc., Oklahoma, Kansas, and Mis- souri.....	850.0	1,110.4	1.6	2.0			120.4	104.6
Texas Inland.....	118.2	137.8	.5	.5			43.8	7.8
Texas Gulf Coast.....	91.8	117.6	.6	.7	(²)	(²)	30.0	10.4
Louisiana Gulf Coast.....	179.2	153.2	.3	.2			26.6	8.2
Rocky Mountain.....	57.8	138.6	.5	.8			.6	.8
California.....	37.8	46.8	.5	.6			16.0	21.6
	28.8	72.0	.1	.1			13.2	30.4
Total United States.....	1,388.4	1,803.4	.5	.5	1,050.0	1,665.5	268.2	187.2

¹ Subject to revision.

² Less than 0.1 percent.

³ Figures not available.

Asphalt and road oil.—The domestic demand for petroleum asphalt rose from 6,618,500 short tons in 1943 to 6,892,800 in 1944, and exports increased from 98,900 to 131,100 tons. Refinery production amounted to 6,996,100 tons in 1944—a gain of 239,400 tons or 3.4 percent. Imports of asphalt have declined steadily since 1941 and amounted to only 90,700 tons in 1944.

The domestic consumption of road oil has been curtailed by the increasing requirements for residual fuel oil. Consumption has decreased from 8,980,000 barrels in 1941 to 2,295,000 in 1943 and to 1,560,000 in 1944.

Detailed statistics for asphalt and road oil appear in the chapter on Asphalt and Related Bitumens.

Still gas.—The production of still gas increased from 312,318 million cubic feet in 1943 to 368,061 million in 1944, or 18 percent. The largest production of still gas by refinery districts in 1944 was 115 billion cubic feet in the Texas Gulf Coast, 66 billion in Indiana, Illinois, Kentucky, etc., 51 billion in the East Coast, 29 billion in the Louisiana Gulf Coast, and 25 billion in Oklahoma, Kansas, etc. Over 90 percent of the still gas is used for fuel at refineries. It represents, however, a potential source from which increasing amounts of liquefied gas and other products may be recovered.

Production of still gas in the United States, 1942-44, by districts

District	1942		1943		1944 ¹	
	Millions of cubic feet	Equivalent, in thousands of barrels	Millions of cubic feet	Equivalent, in thousands of barrels	Millions of cubic feet	Equivalent, in thousands of barrels
East Coast.....	37,530	10,425	44,449	12,347	50,501	14,028
Appalachian.....	9,961	2,767	10,249	2,847	12,319	3,422
Indiana, Illinois, Kentucky, etc.....	56,398	15,666	57,855	16,071	66,294	18,415
Oklahoma, Kansas, and Missouri.....	25,657	7,127	24,059	6,683	25,337	7,038
Texas Inland.....	15,797	4,388	14,080	3,911	15,239	4,233
Texas Gulf Coast.....	85,338	23,705	96,235	26,732	114,966	31,935
Louisiana Gulf Coast.....	10,106	2,807	17,824	4,951	29,462	8,184
Arkansas and Louisiana Inland.....	3,614	1,004	4,280	1,189	4,648	1,291
Rocky Mountain.....	5,556	1,543	5,422	1,506	6,858	1,905
California.....	34,171	9,492	37,865	10,518	42,437	11,788
Total United States.....	284,126	78,924	312,318	86,755	368,061	102,230

¹ Subject to revision.

Miscellaneous oils.—The domestic demand for this group of products has risen from 11,862,000 barrels in 1941 to 30,857,000 barrels in 1944. Probably at least 80 percent of the products in this group are included under the general classification of liquefied gases for fuel uses and for chemical and rubber manufacture; but a substantial increase has occurred in other products, such as toluene and other war materials.

The indicated supply of these products includes transfers of liquefied petroleum gases from natural gasoline and cycle plants that are not included in motor-fuel demand but represent deliveries of these materials for fuel purposes. These transfers rose from 6,281,000 barrels in 1941 to 11,589,000 in 1943 and to 12,652,000 in 1944. The remaining products represent the production of liquefied gases and of other miscellaneous oils at refineries. The total refinery production of these oils rose from 6,266,000 barrels in 1941 to 9,660,000 in 1943 and 18,436,000 in 1944. The refinery output, by classes, is shown for 1942 and 1943, but figures are not yet available for 1944. The indicated production of all types of liquefied gases at refineries rose from 4,755,000 barrels in 1941 to 6,279,000 in 1943.

*Production of miscellaneous oils at refineries in the United States, 1942-43, by districts and classes*¹

[Thousands of barrels]

District	Petrolatum	Absorption oil	Medicinal oil	Specialties	Liquefied gas	Other	Total
1942							
East Coast.....	69	9	70	-----	1,438	200	1,786
Appalachian.....	267	15	-----	6	-----	159	447
Indiana, Illinois, Kentucky, etc.	15	-----	-----	66	1,115	379	1,575
Oklahoma, Kansas, and Missouri	41	39	-----	-----	75	59	214
Texas Inland.....	-----	26	-----	-----	112	98	236
Texas Gulf Coast.....	49	-----	-----	64	392	101	606
Louisiana Gulf Coast.....	29	-----	-----	-----	425	24	478
Arkansas and Louisiana Inland.....	-----	-----	-----	-----	61	25	86
Rocky Mountain.....	6	9	-----	-----	28	30	73
California.....	-----	58	35	92	2,267	164	2,616
Total United States.....	476	156	105	228	5,913	1,239	8,117
1943							
East Coast.....	103	15	73	40	2,344	171	2,746
Appalachian.....	250	40	-----	12	-----	258	560
Indiana, Illinois, Kentucky, etc.	57	17	-----	33	715	581	1,403
Oklahoma, Kansas, and Missouri	186	18	-----	-----	79	72	355
Texas Inland.....	7	39	-----	-----	197	57	300
Texas Gulf Coast.....	72	-----	-----	63	692	667	1,494
Louisiana Gulf Coast.....	44	-----	-----	-----	708	136	888
Arkansas and Louisiana Inland.....	-----	-----	-----	7	302	80	389
Rocky Mountain.....	-----	-----	-----	-----	58	41	99
California.....	-----	31	40	93	1,184	78	1,426
Total United States.....	719	160	113	248	6,279	2,141	9,660

¹ Detailed figures for 1944 not yet available.

WORLD PRODUCTION²

The world production of crude petroleum continued its steadily rising trend (interrupted only in 1930-32, 1938, and 1942). Losses and curtailments in civilian demand during the present war were more than compensated by war demand, and the net result was wider use and greater consumption.

The Western Hemisphere contributed 79 percent of the total world production. The United States alone supplied 64 percent of the world output and Venezuela 10 percent. In the Eastern Hemisphere the U. S. S. R. furnished 10½ percent of the world total.

In the United States, war demands, in spite of rationing civilian use, raised the national crude production 11 percent in 1944 over 1943. Mexico increased its petroleum output 8 percent from 1943 to 1944.

Improved shipping conditions permitted Venezuela to enlarge its petroleum production 45 percent and Colombia 68 percent from 1943 to 1944. On the other hand, the difficulty of obtaining drilling equipment retarded petroleum production in Argentina, in spite of vigorous prospecting by the Government-controlled enterprise that dominated the industry.

Statistical information on the petroleum industry of Europe is still scanty and none too reliable. The U. S. S. R. showed recovery from the German invasion and the temporary capture of certain fields. On the other hand, the Rumanian decrease may be traced to the ravages of bombardment and invasion. In Germany, Austria, and Hungary efforts to step up production were evidently successful.

In the Far East data on petroleum production of Asia are largely

² By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

conjectural. In the Middle East, however, victory in North Africa and clearing of the Mediterranean permitted Iran and Irak to expand their petroleum output.

Crude petroleum produced in principal countries of the world, 1939-44, in thousands of barrels

[Compiled by B. B. Waldbauer]

Country	1939	1940 ¹	1941 ¹	1942 ¹	1943 ¹	1944 ¹
North America:						
Canada.....	7,838	8,591	10,124	10,365	10,052	10,071
Mexico.....	42,898	44,036	42,196	35,152	35,213	38,200
Trinidad.....	19,270	20,211	21,211	25,700	21,386	22,000
United States.....	1,204,922	1,353,214	1,402,228	1,399,645	1,505,013	1,677,723
Other North America.....	112	142	150	150	150	150
Total North America.....	1,335,080	1,426,202	1,475,919	1,458,012	1,572,413	1,748,174
South America:						
Argentina.....	18,613	20,609	21,873	23,704	27,714	24,220
Bolivia.....	215	288	235	308	334	313
Brazil.....	2	2	3	31	80	80
Colombia.....	23,857	25,593	24,553	10,487	13,261	22,291
Ecuador.....	2,313	2,349	1,557	2,278	2,378	2,862
Peru.....	13,508	12,126	11,935	13,629	14,654	14,286
Venezuela.....	206,470	185,570	228,430	147,675	177,631	257,046
Total South America.....	264,976	246,537	288,586	198,112	226,052	321,238
Europe:						
Albania.....	934	1,497	1,381	1,450	715	765
Czechoslovakia.....	120	163	183	271	200	185
France.....	500	496	479	500	600	500
Germany.....	4,487	4,544	4,438	4,500	6,500	7,800
Austria.....	1,240	2,480	2,700	3,800	7,800	9,700
Hungary.....	1,103	1,755	2,474	4,000	9,700	9,900
Italy.....	91	57	77	77	75	75
Poland.....	3,898	3,891	3,319	3,400	3,500	3,000
Rumania.....	45,648	42,644	49,913	41,558	38,631	25,634
U. S. S. R. ²	216,866	218,600	238,150	227,470	200,750	275,000
United Kingdom.....					825	850
Other Europe.....	10	10	10	10	10	10
Total Europe³.....	274,897	276,137	294,124	287,036	269,306	353,279
Asia:						
Bahrain Island.....	7,589	7,074	6,794	(⁴)	(⁴)	(⁴)
Burma.....	7,873	7,731	7,762	2,500	1,000	750
China.....	4	10	86	340	447	505
India, British.....	2,327	2,302	2,899	2,792	2,279	2,500
Iran (Persia).....	78,151	66,221	50,722	73,350	(⁴)	(⁴)
Iraq.....	30,791	24,225	12,650	19,726	24,848	(⁴)
Japan (including Taiwan).....	2,654	2,639	2,659	3,000	3,500	3,000
Netherlands Indies.....	62,087	62,011	53,704	9,000	20,000	40,000
Sakhalin.....	4,000	4,000	4,000	4,000	5,000	5,000
Sarawak and Brunei.....	7,097	7,047	6,964	3,000	4,500	6,000
Saudi Arabia.....	3,934	5,365	5,871	(⁴)	(⁴)	7,794
Total Asia⁵.....	206,507	188,625	154,011	129,949	146,780	205,308
Africa:						
Egypt.....	4,666	6,505	8,546	8,275	8,953	9,125
Other Africa.....	27	27	27	27	25	30
Total Africa.....	4,693	6,532	8,573	8,302	8,978	9,155
Australia and New Zealand.....	3	3	3	3	5	5
Undistributed.....	4	14	14	15	15	14
Grand total.....	2,086,160	2,144,050	2,221,230	2,081,429	2,233,549	2,617,074

¹ Approximate production. Data derived in part from World Petroleum, vol. 12, No. 2, February 1941, pp. 20-21, vol. 13, No. 3, March 1942, p. 88 Oil Weekly, vol. 112, No. 9, Jan. 31, 1944, Trends in the Petroleum Industry—No. 2, May 16, 1945, by the Petroleum Industry War Council and the Foreign Economic Administration.

² Includes U. S. S. R. fields in Asia, other than Sakhalin.

³ Data not available; estimate included in total.

⁴ Approximate production.

⁵ Exclusive of U. S. S. R. fields in Asia, other than Sakhalin, which are included with U. S. S. R. in Europe.

FOREIGN TRADE¹

IMPORTS

Imports of mineral oils, crude and refined, into continental United States increased 45 percent from 1943 to 1944. They constituted 5 percent of the total new supply in continental United States in 1944 compared with 4 percent in 1943.

Crude petroleum, residual fuel oil, and distillate fuel oil made up 89 percent of the total imports in 1943 and 96 percent in 1944. Virtually all these imports came from ports of the Caribbean Sea and the Gulf of Mexico. Venezuela supplied 68 percent of the crude petroleum imported in 1943 and 82 percent in 1944, Colombia 22 percent in 1943 and 17 percent in 1944, and Mexico 10 percent in 1943 but only 1 percent in 1944. Of the residual fuel oil imported in 1943, Netherlands West Indies furnished 95 percent and Trinidad 4 percent; in 1944 Netherlands West Indies shipped 98 percent and Trinidad less than 1 percent. Of the distillate fuel oil imported, Netherlands West Indies sent 84 percent in 1943 and 69 percent in 1944; Venezuela 7 percent in 1943 and 12 percent in 1944; Mexico 6 percent in 1943 and 14 percent in 1944; and Trinidad 1 percent in 1943 and 6 percent in 1944.

Minerals oils, crude and refined, imported into continental United States, 1943-44, by months¹

(Thousands of barrels)

Class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1943													
Crude petroleum.....	254		138	179	72	454	122	2,036	1,568	2,797	2,740	3,473	13,833
Refined products:													
Gasoline, finished.....			2	110	85	1,400	1,049	1,703	176	898	177	136	5,736
Kerosine.....					15	98		167		19	78		375
Distillate fuel oil.....	179	432	166	612	499	4,285	2,174	3,523	978	949	1,141	331	15,269
Residual fuel oil.....	537	1,488	250	1,795	3,448	4,052	3,005	4,258	1,560	2,640	2,199	1,978	27,210
Asphalt.....	46	69	35	49	51	51	50	1	91		88	92	623
Unfinished oils, other.....									98		268		366
	1,016	1,989	591	2,745	4,170	10,340	6,400	11,688	4,471	7,303	6,689	6,010	63,412
1944²													
Crude petroleum.....	3,083	3,183	2,281	3,371	4,217	3,719	3,195	4,975	3,802	5,575	3,377	4,027	44,806
Refined products:													
Gasoline, finished.....	12	10	262	475	925	262	138	227	373	55	320	89	3,148
Kerosine.....	71				76								147
Distillate fuel oil.....	1,322	600	798	599	853	447	468	392	199	228	409	781	7,096
Residual fuel oil.....	2,523	2,822	3,174	3,856	4,035	3,477	3,685	2,950	3,269	2,276	2,239	2,247	36,553
Asphalt.....	50	38	88	4	7	9	99		40	37		126	498
Unfinished oils, other.....		7	2										9
	7,061	6,660	6,605	8,305	10,113	7,914	7,585	8,544	7,683	8,171	6,345	7,270	92,256

¹ Imports of crude as reported to Bureau of Mines; imports of refined products compiled from records of U. S. Department of Commerce; figures may differ slightly from those used throughout other sections of this report.

² Subject to revision.

EXPORTS

Continental United States continued to be a net exporter of mineral oils. The excess of petroleum exports over petroleum imports increased from 86,545,000 barrels in 1943 to 116,655,000 barrels in 1944.

¹ By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

In crude petroleum, an excess of exports over imports amounting to 27,509,000 barrels in 1943 was converted to an excess of imports over exports totaling 10,567,000 barrels. On the other hand, the excess of exports of refined oils increased from 59,036,000 barrels in 1943 to 127,222,000 barrels in 1944. Of the refined oils, only residual fuel oil showed greater imports than exports. Imports of residual fuel oil exceeded exports by 12,316,000 barrels in 1943 and by 22,726,000 barrels in 1944.

In absolute amounts, exports and territorial shipments of mineral oils, both crude and refined, were 39 percent larger in 1944 than in 1943. The principal gains were in outward shipments of motor fuel, followed by distillate fuel oil. In contrast, exports and territorial shipments of crude petroleum and of residual fuel oil were less in 1944 than in 1943.

Of the exports of major refined mineral oils, 70 percent in 1943 and 78 percent in 1944 went to Europe. The United Kingdom received 67 percent of the total in 1943 and 75 percent in 1944, and the U. S. S. R. most of the remainder.

Other North American countries received 8 percent of the total exports in 1943 and 6 percent in 1944. Canada received 5 percent of the whole in 1943 and 3 percent in 1944.

The share of Oceania in the mineral-oil exports of the United States declined from 16 percent in 1943 to 5 percent in 1944.

Major petroleum products shipped from continental United States, by countries of destination, and shipments to and exports from noncontiguous Territories, 1948-44¹

[Thousands of barrels, except wax, which is thousands of pounds]

Country	Motor fuel :			Kerosine			Fuel oil			Lubricating oil			Wax		
	1942	1943	1944	1942	1943	1944	1942	1943	1944	1942	1943	1944	1942	1943	1944
Exports to foreign countries:															
North America:															
Bermuda.....	62	(¹)	(¹)	25	(¹)	(¹)	135				8	2	1	(¹)	1
Canada.....	3,112	2,964	2,522	236	269	186	1,764	1,330	2,210		404	383	18,106	22,441	19,391
Cuba.....	526	303	271	(¹)	(¹)	2	1,258	730	2,343		77	57	3,311	2,117	4,260
Curacao (N. W. I.).....	168	(¹)	(¹)	44	61	86	368	723	883		21	53	13	5	1
Mexico.....	490	603	636	44			563				162	192	5,529	5,581	1,804
Panama: Canal Zone.....	516	44	72	52	(¹)	(¹)	2,188	47			25	9	10	8	
Trinidad and Tobago.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)				60	26	13	45	24
Other North America.....	342	200	68	47	33	22	836	91	47		113	92	78	2,508	6,907
	5,216	4,114	3,569	404	363	296	7,112	2,921	5,434		990	812	748	33,666	32,378
South America:															
Argentina.....	3	(¹)	(¹)	(¹)		(¹)	2	38	52		18	13	12	1,889	
Bolivia.....	67	14	3	1		1	9	(¹)	1		16	20	17	572	3,287
Brazil.....	127	53	30	57	22	4	2	70			298	241	462	1,853	1,353
Chile.....	11	5	18		(¹)	1	52	28	9		90	70	76	2,528	3,586
Colombia.....	4	(¹)	(¹)				(¹)				9	22	29	4,186	10,422
Peru.....	42	10	4		(¹)	(¹)	28	(¹)			29	60	34	1,624	12,732
Surinam.....	(¹)	(¹)	(¹)	4	(¹)	4		(¹)			3	30	25	1,932	7,408
Uruguay.....	(¹)	2	2		(¹)	(¹)		(¹)	2		33	25	20	285	902
Venezuela.....	15	3	1	2			2				34	44	61	1,220	5,641
Other South America.....	4	2	(¹)			3	2	1			24	21	16	1,382	2,460
	273	92	58	64	25	13	143	139	62		549	489	789	16,613	46,317
Europe:															
Azores and Madeira Islands.....															
Elze.....	43	(¹)	(¹)	42					30		1	(¹)	5	173	1,515
Portugal.....	3		1	1	(¹)	(¹)	59	(¹)	(¹)		13	40	40	421	721
Spain.....	265						82				25	46	63	1,683	596
Sweden.....	879	4,576	(¹)	7		39	363	294	67		32	32	73	8	580
U. S. R.....	2,709				17		44		812		116	62	240	923	670
United Kingdom.....	31,063	75,891	(¹)	1,671	3,782	4,168	18,297	27,444	43,823		3,050	2,969	3,833	5,979	14,273
Other Europe.....	20,495	94					4				2	6	13	76,544	64,236
	21,685	33,870	80,534	1,721	3,799	4,207	18,989	27,709	44,232		3,238	3,223	4,279	96,683	68,877

See footnotes at end of table.

Major petroleum products shipped from continental United States, by countries of destination, and shipments to and exports from noncontiguous Territories, 1942-44—Continued
 [Thousands of barrels, except wax, which is thousands of pounds]

Country	Motor fuel :			Kerosine			Fuel oil			Lubricating oil			Wax		
	1942	1943	1944	1942	1943	1944	1942	1943	1944	1942	1943	1944	1942	1943	1944
Exports of foreign countries—Continued															
Asia:															
British Malaya.....			3,769	(¹)							9	43	37	3	
Ceylon.....		(¹)	1								38	17	1	2	
China and Hong Kong.....	189	4	2,271	40	(¹)	2	(¹)				926	1,133	871	10	138
India and Dependencies.....	(¹)	(¹)									149	62	17		261
Iran.....		(¹)									89	77	35		6
Iraq.....		(¹)							1		20	38	38	28	
Turkey.....		(¹)							(¹)		54	108	46	15	344
Other Asia.....														301	28
	189	4	6,041	40	(¹)	2	1				1,321	1,440	745	58	633
Africa:															
Belgian Congo.....	(¹)	50	(¹)		4						76	35	30	11	46
Egypt.....	2,245	1,537	2,168	(¹)	(¹)	9					719	634	401	1,204	162
Gold Coast.....	110	128	95	(¹)	2		(¹)	4	56	11	45	27	18	(¹)	155
Liberia.....	49	3	(¹)		1						2	1	1	8	97
Morocco.....	(¹)	5	70	(¹)	(¹)	1	(¹)		(¹)		1	(¹)	(¹)		7
Nigeria.....	203	(¹)	1	(¹)	(¹)	(¹)					45	12	17	(¹)	
Union of South Africa.....	72	46		2	228	116					186	356	367	5,091	19,239
Other Africa.....					8	14				28	95	237	219	56	920
	2,684	1,718	2,380	4	27	24	247	185		39	1,169	1,302	1,053	6,370	20,433
															9,333
Oceania:															
Australia.....	2,451	7,433	3,519	179	166		1,004	3,389	748		651	1,062	977	1,296	5,780
British Oceania.....	48	19	8	8	12		56	2	(¹)		6	2	3		4,283
New Guinea (Australian).....	471	1,125	2,065	73	45	2	1,362	1,735	445		77	188	95	1,005	5,580
New Zealand.....	14	15	18	6	5	6	5	8	4		3	4	2		45
Other Oceania.....															
	2,984	8,592	5,789	266	224	20	2,427	5,134	1,197		767	1,276	1,077	2,301	11,360
															4,328
Total exports to foreign countries.....	33,031	48,390	98,371	2,499	4,438	4,560	28,820	36,089	50,964		7,974	8,542	8,661	153,445	172,789
															161,886

Shipments to noncontiguous Territories:													
Alaska.....	680	940	361	12	223	213	1,265	1,391	1,105	145	223	136	70
Hawaii.....	1,450	2,645	1,939	5	(¹)	(¹)	3,514	2,531	4,004	78	92	107	83
Puerto Rico.....	3	3	1	5	6	6	126	2	7	45	33	81	77
Virgin Islands.....	37	23	39	(¹)	6	(¹)	8	18	1	(¹)	1	(¹)	---
Other.....	(¹)	---	(¹)	(¹)	(¹)	(¹)	---	---	---	(¹)	---	(¹)	---
Exports from noncontiguous Territories:													
Alaska.....	2,170	3,510	2,340	23	229	219	4,933	3,942	5,166	273	349	345	160
Puerto Rico.....	46	10	---	---	---	---	6	7	---	1	---	---	---
Alaska.....	35	26	---	7	6	---	10	8	---	---	---	33	---
Puerto Rico.....	81	36	---	7	6	---	16	15	---	1	---	33	---
Total shipments from United States.....	35,120	51,964	100,711	2,515	4,661	4,779	33,737	40,016	56,130	8,246	8,891	9,006	172,961
													162,046

¹ Compiled from records of U. S. Department of Commerce.

² Includes natural gasoline, naphtha, benzol, and antiknock compounds.

³ Less than 1,000 barrels.

⁴ Less than 1,000 pounds.

Mineral oils, crude and refined, shipped from continental United States, including shipments to noncontiguous Territories, 1943-44, by classes and months¹

(Thousands of barrels)

Class	January	February	March	April	May	June	July	August	September	October	November	December	Total
1943													
Crude petroleum.....	2, 017	2, 416	2, 469	4, 155	4, 707	4, 325	4, 932	4, 011	3, 441	3, 370	3, 415	2, 084	41, 342
Refined products:													
Motor fuel ²	3, 075	2, 430	3, 183	3, 158	4, 023	4, 033	6, 801	5, 928	6, 807	4, 744	4, 020	3, 375	51, 577
Kerosene.....	346	177	343	556	291	221	3, 791	719	809	91	374	34	4, 752
Distillate fuel oil.....	1, 508	1, 456	1, 863	2, 426	2, 363	2, 358	3, 478	2, 854	1, 912	1, 820	1, 365	1, 554	24, 937
Residual fuel oil.....	1, 138	934	1, 064	1, 490	1, 630	818	2, 474	1, 582	609	1, 536	873	746	14, 894
Lubricating oil.....	733	578	591	564	776	824	1, 000	593	809	950	699	746	8, 863
Paraffin wax.....	51	40	70	60	48	79	52	54	44	32	42	45	617
Coke.....	62	63	118	148	189	139	163	135	127	170	156	100	1, 570
Asphalt.....	20	32	38	49	91	65	88	88	32	17	60	21	544
Miscellaneous oils.....	45	59	71	61	146	53	66	57	61	71	72	79	841
Total refined.....	6, 978	5, 769	7, 241	8, 662	9, 417	8, 590	14, 913	11, 953	11, 210	9, 431	7, 661	6, 790	108, 615
Total crude and refined.....	8, 995	8, 185	9, 710	12, 817	14, 124	12, 915	19, 845	15, 964	14, 651	12, 801	11, 076	8, 874	149, 937
1944 ³													
Crude petroleum.....	2, 488	1, 904	2, 105	2, 891	3, 136	3, 642	3, 516	3, 387	3, 354	2, 990	3, 001	1, 824	34, 238
Refined products:													
Motor fuel ²	5, 172	5, 694	5, 404	7, 302	9, 496	11, 046	9, 582	11, 045	9, 067	10, 967	7, 504	7, 760	100, 639
Kerosene.....	245	145	195	401	375	390	729	950	212	404	447	272	4, 765
Distillate fuel oil.....	1, 677	2, 386	2, 325	4, 109	4, 215	5, 497	5, 398	5, 704	3, 912	3, 707	2, 329	2, 086	43, 345
Residual fuel oil.....	549	1, 078	1, 400	841	1, 872	1, 902	1, 422	812	679	886	1, 425	901	13, 827
Lubricating oil.....	601	655	732	652	1, 006	883	917	879	712	748	450	654	8, 889
Paraffin wax.....	36	41	60	43	57	40	55	50	40	54	57	45	578
Coke.....	105	106	94	100	105	66	115	138	102	71	29	14	1, 045
Asphalt.....	85	110	47	33	32	87	76	45	64	56	41	721	1, 045
Miscellaneous oils.....	58	83	82	75	88	68	50	66	56	82	76	80	864
Total refined.....	8, 528	10, 268	10, 369	13, 556	17, 246	20, 579	18, 344	19, 689	14, 844	16, 975	12, 358	11, 857	174, 673
Total crude and refined.....	11, 016	12, 202	12, 504	16, 447	20, 382	24, 221	21, 860	23, 076	18, 198	19, 965	15, 359	13, 681	208, 911

¹ Exports of crude as reported to Bureau of Mines; export and shipments of refined products compiled from records of U. S. Department of Commerce; figures may differ slightly from those used throughout other sections of this report.

² Includes benzol, natural gasoline, and antiknock compounds.

³ Subject to revision.

INTERCOASTAL SHIPMENTS ¹

Receipts of mineral oils, crude and refined, on the East Coast from Gulf Coast ports were 25 percent larger in 1944 than in 1943, but amounted to only 18 percent of the corresponding shipments of 1941. Gasoline was the largest single item in these shipments and constituted 30 percent of the total shipments in 1944, compared with 37 percent in 1943. The 1944 intercoastal shipments of gasoline were 3 percent larger than those of 1943. Shipments of kerosine were slightly larger in 1944 than in 1943, and shipments of residual fuel oil gained 57 percent over 1943. On the other hand, shipments of distillate fuel oil were 11½ percent less in 1944 than in 1943.

Mineral oils, crude and refined, shipped commercially from Gulf Coast to East Coast ports of the United States, 1943-44, by classes ¹

[Thousands of barrels]

Class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1943													
Crude petroleum...	602	638	447	63	282	510	.....	557	511	910	302	166	4,968
Gasoline.....	1,795	1,309	1,580	2,013	1,842	1,917	1,556	2,197	1,816	2,014	2,050	2,342	22,431
Kerosine.....	388	287	325	288	213	127	547	180	597	667	638	859	5,116
Distillate fuel oil....	610	1,303	629	155	386	354	907	845	1,573	1,698	3,299	3,073	14,832
Residual fuel oil....	678	1,073	1,000	1,068	919	920	1,124	1,286	1,240	1,537	1,042	1,159	13,046
Lubricating oil.....	.....	.....	.....	.....	.....	.....	3	.....	.....	.....	.....	.....	3
Miscellaneous oils..	55	54	77	76	136	146	34	5	84	66	106	12	851
	4,128	4,664	4,058	3,663	3,778	3,974	4,171	5,070	5,821	6,892	7,437	7,611	61,267
1944													
Crude petroleum...	253	782	1,716	344	209	.....	225	939	1,857	2,809	2,315	2,799	14,248
Gasoline.....	1,902	2,021	2,113	2,121	1,882	2,157	2,047	2,053	1,429	1,770	1,811	1,827	23,133
Kerosine.....	922	609	295	90	259	96	393	224	542	441	799	515	5,185
Distillate fuel oil....	1,063	749	646	257	383	501	529	1,305	970	2,063	2,400	2,227	13,123
Residual fuel oil....	1,320	1,627	1,574	1,370	1,371	1,250	1,656	2,076	1,919	1,867	2,448	1,975	20,453
Miscellaneous oils..	8	3	6	11	50	11	25	48	16	16	.....	.....	194
	5,498	5,791	6,350	4,193	4,154	4,015	4,875	6,645	6,733	8,966	9,773	9,343	76,336

¹ Petroleum Conservation Division (U. S. Department of the Interior) and Petroleum Administration for War.

² By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

NATURAL GASOLINE

AND LIQUEFIED PETROLEUM GASES ¹

By F. S. LOTT AND A. T. COUMBE

SUMMARY OUTLINE

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NATURAL GASOLINE

SUMMARY

Continued expansion of production and demand to record levels were reported by the natural-gasoline industry in 1944. The total output of light products derived from natural gas increased 14 percent over 1943 to 4,201,932 thousand gallons with an estimated value at the plants of \$182,500,000 (24 percent more than in 1943). Although the production of liquefied petroleum gases increased rapidly (29 percent above 1943), the supply was inadequate to meet all demands. The output of cycle plants, other than liquefied gases, was 28 percent higher and natural-gasoline production 3 percent higher than in 1943.

The market for light products remained strong in 1944, reflecting heavy demand for many war purposes. The spot price for 26-70 grade natural gasoline in the Mid-Continent (Group 3) area had advanced to 4.75 cents per gallon in October 1943 and was unchanged throughout 1944. The average price for the year was therefore 4.75 cents, compared with 4.13 cents in 1943.

Stocks of all light products declined from 190,722,000 gallons on January 1, 1944, to 178,584,000 gallons on December 31, owing to depletion of inventories at refineries, particularly on the East coast and in California. Stocks at plants and terminals were little changed.

Exports in 1944—42,696,000 gallons—were 21 percent above 1943 but far below the average of prewar years. Recent shipments have been limited almost entirely to Canada and Mexico.

¹ Data for 1944 are preliminary; detailed statistics with final revisions will be released later.

² Tables compiled by E. M. Seeley, Petroleum Economics Division, Bureau of Mines.

Salient statistics of the natural-gasoline industry in the United States, 1940-44, in thousands of gallons

	1940	1941	1942	1943	1944 ¹
Production:					
Natural gasoline.....	2,173,710	2,208,360	2,071,104	2,115,372	2,188,264
Cycle products, except liquefied petroleum gases.....	165,600	480,354	654,864	657,846	843,024
Liquefied petroleum gases at natural gasoline and cycle plants:					
Isobutane.....	(²)	127,932	101,682	150,738	209,034
Other L. P. G.....	(²)	579,264	671,874	760,116	981,580
Benzol.....	(²)	(²)	100,674	100,900	100,800
Total.....	2,339,400	3,396,910	3,600,198	3,784,872	4,302,782
Stocks at plants, terminals, and refineries, end of year:					
Natural gasoline.....	{ 239,568	{ 171,276	{ 157,374	{ 130,410	{ 114,702
Cycle products.....	{ (²)	{ 8,274	{ 13,524	{ 15,268	{ 17,430
Liquefied petroleum gases.....		{ 6,804	{ 23,646	{ 45,024	{ 46,452
Total.....	239,568	{³ 179,550	194,544	190,722	178,584
Demand:					
Used at refineries.....	1,660,974	2,008,650	2,378,900	2,570,316	2,822,694
Sales to jobbers, retailers, etc.:					
Natural gasoline and cycle products.....	283,290	837,858	415,800	292,152	263,218
L. P. G. for fuel.....	(²)	263,802	302,190	486,738	531,384
Transfers of cycle products.....	(²)	(²)	(²)	66,108	76,482
Exports.....	71,526	53,886	57,414	35,154	42,696
Losses and unidentified uses.....	269,724	291,732	439,614	238,226	588,296
Total.....	2,285,514	3,455,928	3,692,008	3,788,694	4,314,870
Sales to consumers for fuel and chemical uses:⁴					
Liquefied refinery gases.....	{ 313,456	{ 199,038	{ 223,272	{ 179,676	{ 421,396
Liquefied petroleum gases.....		{ 263,814	{ 362,168	{ 495,557	{ 640,423
Total.....	313,456	462,852	585,440	675,233	1,061,809
Value at plants:					
Natural gasoline.....thousands of dollars.....	{ 68,261	{ 88,877	{ 78,170	{ 95,278	{ 110,000
Cycle products.....do.....		{ 16,938	{ 24,395	{ 27,227	{ 38,200
Liquefied petroleum gases.....do.....	{ (²)	{ 13,306	{ 19,000	{ 24,410	{ 34,300
Average per gallon.....cents.....	2.9	3.5	3.5	4.0	4.3
Natural gas treated.....millions of cubic feet.....	2,471,400	2,763,300	2,864,400	3,028,000	3,300,000
Average yield of natural gasoline per M cubic feet.....gallons.....	0.95	0.97	0.95	0.92	0.92
Average yield, all light products.....do.....	(²)	1.23	1.22	1.22	1.27

¹ Subject to revision.

² Not available.

³ For comparison with 1940.

⁴ Figures from data compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

⁵ Includes liquefied gases used in chemical manufacturing.

⁶ From independent survey of consumption. See discussion on Liquefied Petroleum Gases at end of this chapter.

Estimated.

PRICES AND MARKET CONDITIONS

The price ceiling on the 26-70 grade of natural gasoline in Oklahoma, originally set at 4.875 cents a gallon by the Office of Price Administration, was revised downward to 4.75 cents, a figure considered more representative of actual realization by producers in the base period—the 60 days prior to October 15, 1941. The spot price coincided with this ceiling during 1944, and ceilings on other light products in tank cars were unchanged except for minor adjustments in a few districts.

On tank-wagon deliveries of commercial grades of liquefied gases, the ceiling price was raised 2 cents per gallon to compensate for higher costs of distribution.

As in 1943, light products entering into the manufacture of such critical war items as aviation gasoline and synthetic rubber were not restricted in price. Influenced primarily by this free market portion

of sales, the average value at the plants of natural gasoline and cycle products is estimated to have increased from 4.4 cents a gallon in 1943 to 4.9 cents in 1944.

Because of diversion of tetraethyl lead and high-octane gasoline components to military production, refiners were unable to maintain the 72-74 octane specification for civilian-grade motor fuel. The requirement was therefore relaxed to 70-74 octane on August 15, 1944, and the price ceiling at refineries and bulk terminals was reduced one-eighth cent per gallon. The average spot price in Oklahoma for this grade of United States motor fuel was 5.96 cents per gallon in 1943 (ceiling, 6.00 cents), and 5.95 cents, the average ceiling price in 1944 (see fig. 1).

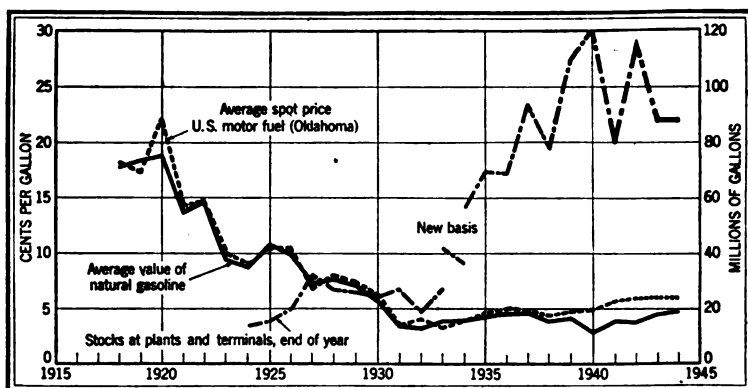


FIGURE 1.—Trends in average value of natural gasoline, spot price of gasoline, and stocks of natural gasoline, 1918-44

PRODUCTION

Trends in total output.—The production of crude petroleum increased 11 percent in 1944, and that of natural gasoline and cycle products (except L. P. G.) increased 9 percent to new high levels (see fig. 2). The monthly trend of both series was upward, responding to growing demands of the war economy.

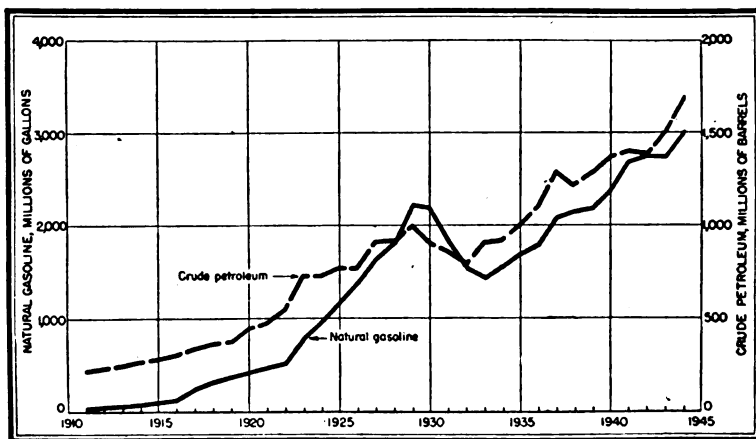


FIGURE 2.—Annual production of natural gasoline and crude petroleum, 1911-44

A small gain (3 percent) restored natural-gasoline output to the approximate level of 1940-41. The output of cycle products and liquefied petroleum gases in 1944 was 76 percent and 66 percent, respectively, greater than in 1941. One large new cycle plant in Louisiana and one in California contributed to the 1944 production.

The total liquid production at natural-gasoline and cycle plants averaged 10.8 million gallons daily in the first quarter of 1944 and 12.2 million gallons in the fourth quarter. The total output of 4,201.9 million gallons equaled 6 percent of the volume of crude petroleum produced in the United States in 1944.

Natural gasoline and cycle products produced in the United States, 1940-44, by States, in thousands of gallons

Year	Arkansas	California	Colorado	Illinois	Kansas	Kentucky	Louisiana	Michigan	Montana	New Mexico
1940.....	32,096	587,476	380	21,499	64,691	9,539	113,741	3,919	2,603	55,713
1941.....	28,108	577,127	390	54,872	72,876	10,247	201,049	5,670	2,517	69,116
1942.....	34,033	545,881	346	66,389	68,948	8,884	254,362	2,518	2,810	73,862
1943.....	40,353	582,872	408	71,737	70,325	10,571	265,807	1,226	2,749	73,126
1944 ¹	43,701	632,768	² 310	61,351	54,045	10,997	409,824	4,055	2,886	69,528

Year	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming ³	Total		
								Thousands of gallons ⁴	Value at plant	
									Thousands of dollars	Average per gallon (cents)
1940....	17	8,062	399,369	15,371	932,040	58,782	34,102	2,339,400	68,261	2.9.
1941.....	17	8,217	362,247	15,440	1,180,221	65,873	34,728	2,688,714	105,815	3.9
1942.....	15	6,975	336,707	14,876	1,207,901	67,987	33,474	2,725,968	102,565	3.8
1943.....	12	6,495	309,942	17,084	1,221,736	65,691	33,024	2,773,218	122,500	4.4
1944 ¹	12	7,282	301,246	17,023	1,325,801	57,298	33,181	3,031,308	⁵ 148,200	4.9

¹ Subject to revision.

² Estimated.

³ Includes Utah in each year.

⁴ Includes cycle products as follows—1940: 165,690,000 gallons; 1941: 480,354,000 gallons; 1942: 654,864,000 gallons; 1943: 657,846,000 gallons; 1944: 843,024,000 gallons.

California.—The total output of plants increased 11 percent over 1943 to a new record of 771.3 million gallons. Natural-gasoline production was 9 percent larger in 1944 and liquefied petroleum gases 25 percent larger than in 1943. A total of 171 million gallons of light products was produced at Kettleman Hills compared with 143 million in 1943. The Ventura Avenue field ranked second in the State, with an output of 86 million gallons in 1944, and Long Beach third, with 81 million gallons.

Louisiana.—Production from the Erath cycle plant in the Gulf district, which began operations in April, caused the total light products output of the State to gain 61 percent in 1944 to 492.6 million gallons. Louisiana became the third State in volume of production, displacing Oklahoma. The output of cycle products and liquefied petroleum gases was 90 and 106 percent, respectively, above that in 1943. Natural gasoline increased only 5 percent and amounted to 24 percent of total production in 1944, compared with 52 percent in 1941.

Monthly production of natural gasoline and allied products in the United States, 1943-44, by States and districts, in millions of gallons

Field	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1943													
West New York and West Pennsylvania.....	1.8	1.6	1.8	1.7	1.2	.9	.9	1.1	1.4	1.7	1.7	1.8	17.6
West Virginia.....	9.9	9.6	10.1	9.1	7.7	6.1	6.6	6.6	6.8	8.0	8.8	8.7	98.0
Ohio.....	.6	.6	.7	.5	.5	.4	.4	.4	.5	.5	.6	.8	6.5
Illinois.....	13.5	12.8	13.9	14.3	14.7	14.6	14.9	16.0	16.6	18.4	18.0	17.8	185.5
Kentucky.....	4.0	3.9	4.5	4.1	3.4	2.8	3.0	3.2	3.4	3.9	3.5	3.6	43.3
Michigan.....	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	1.2
Kansas.....	7.6	7.5	7.4	6.9	6.6	6.2	6.3	6.6	7.2	7.8	7.8	7.3	85.2
Oklahoma.....	36.4	34.4	36.1	34.5	34.6	34.1	34.8	35.4	35.0	37.0	35.0	35.0	422.3
Texas:													
Gulf.....	27.7	27.1	29.6	29.4	29.9	28.5	32.7	33.0	35.8	36.3	37.2	39.4	386.6
East Texas.....	23.5	22.3	25.4	26.9	27.7	26.1	28.8	28.9	28.5	28.2	26.1	25.8	318.2
Panhandle.....	34.0	30.1	32.6	31.6	32.7	30.8	30.9	31.8	33.0	35.9	35.7	36.1	395.2
Rest of State.....	45.8	41.0	45.8	42.9	44.6	44.0	44.9	45.5	47.2	49.2	47.9	47.2	546.0
Total Texas.....	131.0	120.5	133.4	130.8	134.9	129.4	137.3	139.2	144.5	149.6	146.9	148.5	1,646.0
Arkansas.....	3.3	3.4	3.4	3.4	5.0	5.1	5.6	5.6	5.6	5.7	5.3	5.4	56.8
Louisiana:													
Gulf.....	6.6	6.4	6.8	7.1	7.2	6.9	7.2	7.1	6.7	7.1	6.2	7.0	82.3
Inland.....	19.2	17.5	19.7	18.1	16.8	17.4	17.9	17.5	18.8	19.0	20.4	21.5	228.8
Total Louisiana.....	25.8	23.9	26.5	25.2	24.0	24.3	25.1	24.6	25.5	26.1	26.6	28.5	306.1
New Mexico.....	7.5	6.4	7.1	6.5	6.6	6.8	7.3	7.7	6.5	6.4	6.2	6.0	81.0
Montana.....	.4	.4	.4	.4	.4	.4	.3	.3	.3	.4	.4	.6	4.7
Colorado, Utah, and Wyoming.....	3.2	3.0	3.1	3.1	2.9	2.7	2.8	3.0	2.9	3.2	3.3	3.4	36.6
California.....	55.3	50.5	56.5	56.5	59.0	58.0	60.4	60.8	58.4	59.9	58.3	59.7	693.3
Total United States.....	300.4	278.6	305.0	297.1	301.6	291.9	305.8	310.6	314.7	328.7	322.5	327.2	3,684.1
Daily average.....	9.7	10.0	9.8	9.9	9.7	9.7	9.9	10.0	10.5	10.6	10.8	10.6	10.1
1944¹													
West New York and West Pennsylvania.....	1.9	1.7	1.8	1.7	1.3	1.0	.9	1.0	1.2	1.6	1.6	1.8	17.5
West Virginia.....	9.0	8.2	8.7	7.8	7.0	6.1	5.8	5.6	6.4	7.9	7.8	8.6	88.9
Ohio.....	.9	.8	.8	.7	.4	.4	.4	.4	.5	.6	.6	.8	7.3
Illinois.....	17.6	16.7	18.0	15.7	16.0	15.0	15.2	15.8	15.2	16.7	16.5	16.0	194.4
Kentucky.....	4.0	3.8	4.1	3.8	3.5	3.2	3.8	4.1	4.3	4.9	4.9	4.3	48.7
Michigan.....	.1	.2	.2	.2	.8	.9	1.0	1.0	.9	1.1	1.0	1.1	8.5
Kansas.....	6.6	5.9	6.0	6.1	5.8	5.5	5.2	5.3	5.5	6.0	6.1	5.8	69.8
Oklahoma.....	34.4	33.7	35.4	34.8	34.9	33.9	34.9	35.2	35.1	36.9	36.3	36.3	421.8
Texas:													
Gulf.....	38.4	34.7	36.8	36.2	38.0	36.8	38.5	38.8	36.7	42.2	41.3	44.1	462.5
East Texas.....	25.7	26.5	26.8	25.9	27.1	27.4	29.4	30.4	28.7	29.3	27.2	27.2	331.6
Panhandle.....	38.4	39.1	41.7	39.6	37.2	36.2	38.4	35.7	37.4	37.2	43.8	39.8	464.5
Rest of State.....	47.8	44.5	48.5	47.8	51.0	50.1	53.4	53.6	51.8	54.6	52.3	56.4	611.8
Total Texas.....	150.3	144.8	153.8	149.5	153.3	150.5	159.7	158.5	154.6	163.3	164.6	167.5	1,870.4
Arkansas.....	5.2	5.8	6.2	6.1	6.2	6.2	6.4	6.5	6.4	6.3	6.8	7.4	75.5
Louisiana:													
Gulf.....	6.1	6.9	6.9	8.7	21.3	26.4	28.8	28.7	27.8	27.8	27.2	27.4	244.0
Inland.....	22.7	20.5	21.2	20.9	20.3	19.7	19.5	19.3	19.3	20.9	20.6	21.4	248.6
Total Louisiana.....	28.8	27.4	28.5	29.9	42.2	46.7	48.5	48.2	47.1	48.7	47.8	49.8	492.6
New Mexico.....	5.8	6.7	6.6	6.7	7.1	6.7	7.2	7.6	7.2	7.1	6.5	6.0	81.2
Montana.....	.5	.5	.4	.5	.3	.3	.3	.3	.3	.3	.5	.6	4.8
Colorado, Utah, and Wyoming.....	2.5	3.2	4.0	3.8	4.1	4.1	4.1	4.6	4.7	4.8	4.7	4.6	49.2
California.....	60.9	58.3	63.6	61.5	64.7	63.3	66.4	66.8	65.4	67.2	64.9	68.3	771.3
Total United States.....	328.5	317.7	338.1	328.8	347.6	343.8	359.8	360.9	354.8	373.4	370.6	377.9	4,201.9
Daily average.....	10.6	11.0	10.9	11.0	11.2	11.5	11.6	11.6	11.8	12.0	12.4	12.2	11.5

¹ Subject to revision.

Oklahoma.—The slow decline in total output of recent years appears to have ended in 1944, when 421.8 million gallons of light products were produced, compared with 422.3 million in 1943. Production early in 1944 was below comparable months of 1943, but the daily average for the last quarter of 1.22 million gallons was 2 percent

higher than the comparable 1943 figure. The Osage output of 75 million gallons was 8 million gallons above 1943. Oklahoma City declined 7 million gallons to 53 million in 1944.

Texas.—Total production of 1,870.4 million gallons exceeded the old 1943 record by 14 percent. Increased output over 1943 was reported for all classes of products as follows: Natural gasoline 8 percent, cycle products 9 percent, and liquefied gases 28 percent. All districts gained in 1944, led by the Gulf Coast and the Panhandle. Although productive facilities were added to many plants, the only new plant of large capacity to commence operations in 1944 was in the Wasson field of West Texas.

Natural gasoline and allied products produced and natural gas treated in the United States in 1943-44, by States

State	Number of operators ¹	Natural gasoline		Cycle products		Liquefied petroleum gases		Natural gas treated		
		Thousands of gallons	Thousands of dollars	Thousands of gallons	Thousands of dollars	Thousands of gallons	Thousands of dollars	Millions of cu. ft.	Average yield (gallons per M cu. ft.)	
									Natural gasoline (including cycle products)	All light products
1943										
Arkansas.....	6	40,353	1,867	-----	-----	16,484	335	43,309	0.93	1.31
California.....	32	582,872	24,287	-----	-----	110,460	3,388	349,383	1.67	1.98
Colorado.....	-----	468	25	-----	-----	-----	-----	-----	-----	-----
Illinois.....	15	71,737	4,072	-----	-----	113,750	3,358	32,200	2.23	5.76
Kansas.....	9	70,325	2,967	-----	-----	14,881	471	196,043	.36	.43
Kentucky.....	4	10,571	545	-----	-----	32,746	675	46,149	.23	.94
Louisiana.....	17	112,213	4,655	153,594	5,959	40,255	1,160	236,286	1.12	1.30
Michigan.....	2	1,226	59	-----	-----	-----	-----	835	1.47	1.47
Montana.....	1	2,749	180	-----	-----	1,915	110	11,950	.23	.39
New Mexico.....	7	73,126	3,302	-----	-----	7,879	187	94,194	.78	.86
New York.....	1	12	1	-----	-----	-----	-----	4	3.00	3.00
Ohio.....	5	6,495	362	-----	-----	-----	-----	39,106	.17	.17
Oklahoma.....	41	309,942	15,663	-----	-----	112,371	2,858	188,029	1.65	2.25
Pennsylvania.....	48	17,084	893	-----	-----	450	40	53,616	.32	.33
Texas.....	94	717,484	31,507	504,252	21,268	424,295	10,387	1,520,043	.80	1.08
Utah.....	-----	666	35	-----	-----	-----	-----	-----	-----	-----
West Virginia.....	17	65,691	3,155	-----	-----	32,251	1,300	198,636	.33	.49
Wyoming.....	5	32,358	1,698	-----	-----	3,117	141	18,217	1.78	1.95
	252	2,115,372	95,273	657,846	27,227	910,854	24,410	3,028,000	.92	1.22
1944²										
Arkansas.....	9	43,701	2,190	-----	-----	31,835	800	()	()	()
California.....	29	632,768	28,530	-----	-----	138,512	4,445			
Colorado.....	(³)	(³)	(³)	-----	-----	-----	-----			
Illinois.....	15	61,351	3,870	-----	-----	133,018	4,130			
Kansas.....	9	54,045	2,600	-----	-----	15,789	525			
Kentucky.....	4	10,997	650	-----	-----	37,745	900			
Louisiana.....	19	118,170	5,800	291,654	12,835	82,835	2,665			
Michigan.....	1	4,055	210	-----	-----	4,445	147			
Montana.....	2	2,886	200	-----	-----	1,882	110			
New Mexico.....	6	69,528	3,345	-----	-----	11,633	326			
New York.....	1	12	1	-----	-----	-----	-----			
Ohio.....	5	7,282	440	-----	-----	-----	-----			
Oklahoma.....	40	301,246	17,200	-----	-----	120,522	3,400			
Pennsylvania.....	40	17,023	990	-----	-----	472	42			
Texas.....	88	774,431	38,784	551,370	25,365	544,618	14,765			
Utah.....	(³)	(³)	(³)	-----	-----	-----	-----			
West Virginia.....	17	57,298	3,210	-----	-----	31,619	1,335			
Wyoming.....	5	33,491	1,980	-----	-----	15,669	710			
	236	2,188,284	110,000	843,024	38,200	1,170,624	34,300	3,300,000	.92	1.27

¹ A producer operating in more than 1 State is counted but once in arriving at total for United States.

² Subject to revision.

³ Drip gasoline produced in Colorado and Utah included with Wyoming.

⁴ Not available.

Other States.—Arkansas production continued to expand rapidly (33 percent), as more of its available "sour" gas was processed for removal of sulfur and liquid hydrocarbons. The output of the Rocky Mountain States and Kentucky increased moderately, and the small Michigan production was raised 608 percent in 1944. Illinois production was 9 million gallons higher than in 1943 but followed a declining trend after the peak month of October 1943. Recovery of liquefied gases in Illinois gained about 19 million gallons, and natural gasoline declined 10 million gallons.

The only notable declines in output were in Kansas (18 percent) and West Virginia (9 percent). The former was related to the down trend in crude petroleum production and the latter to reduced recovery from the important Charleston gas field.

POSTWAR OUTLOOK

A projection of current information to the end of 1945 suggests the following situation. The effective capacity of the industry to produce will amount to approximately 6,000 million gallons (148 million barrels) per year. Equipment will be available to recover at least 2,200 million gallons of this total in the form of liquefied gases of the pentane and lighter series. Of the remainder, about 3,500 million gallons may be classified as natural gasoline and other unfinished materials and 300 million gallons as other products (chiefly finished gasoline).

Actual production of light products at natural-gasoline and cycle plants in 1941, the prewar peak year, was 3.4 billion gallons, or 43 percent less than the prospective capacity mentioned above. Of this total, refiners used about 2.3 billion gallons; jobbers, exports, and losses took 0.8 billion; and liquefied-gas markets for fuel and chemical manufacturing accounted for about 0.3 billion.

Assuming that refiners will utilize the same quantity of light products in the first postwar year as in 1941, the natural-gasoline industry will have available capacity to produce about 3.7 billion gallons of products for other markets. The demand for liquefied gases for fuel and chemical uses may be expected to absorb 0.9 billion gallons, judging from the rapid growth trend of the recent past. It is estimated that other sales and losses will account for about 1.0 billion gallons.

These figures indicate that the available capacity of the industry may exceed prospective markets by 1.8 billion gallons annually (or 30 percent of total capacity), of which about one-third will be suitable for recovery of liquefied gases and two-thirds for natural gasoline and other products. A material reduction in the rate of petroleum production after the war might reduce the potential excess temporarily to about 1.2 billion gallons.

It therefore appears that a large potential supply of products will be overhanging the market, for which no buyers will be found in the immediate postwar period. Curtailed production and comparatively low prices for most products at the plants are probable, until broader

markets can be developed. As a large section of the industry has the status of a byproduct operation associated with crude petroleum production or natural-gas pipe lines, the response to market conditions will not be uniform. Curtailment of output at many plants may take the form of less complete recovery of available liquids, with attendant increased losses where the residue gas is not utilized for other purposes. Small marginal plants selling in the open market may find their positions seriously impaired. Cycle plants will occupy the strongest position because of low production costs and adaptability of operations.

The price structure will be profoundly influenced, as always, by the level of motor-fuel prices at refineries, which in turn is closely related to the delivered cost of crude petroleum. Reasonably stable crude prices, which seem probable for several years, tend to maintain a floor under prices of all products and may be expected to mitigate the severity and duration of price depressions for the natural group.

With free market conditions, a period of low prices will provide a strong sales stimulus for the industry as a whole because of the many points of close competitive contact with materials from other sources, the costs and price habits of which are often less flexible. Continued rapid expansion in use of liquefied gases for both established and new purposes may be expected to alleviate problems of surplus supply in this section of the industry. The major difficulty appears to be that of obtaining satisfactory markets for natural gasoline and similar broad fractions. This challenges the technical ingenuity of the industry and its resourcefulness in the field of marketing. Processing changes to produce more products suitable for direct marketing to the public, particularly motor fuel, will doubtless play a part, as will an aggressive program of market development.

MARKET DEMAND

The total demand for light products, including liquefied gases sold by petroleum refineries for fuel purposes, increased 14 percent in 1944 to 4,498,704 thousand gallons. The consumption of all major product groups was higher in 1944 than in 1943 by the following percentages: Natural gasoline 3 percent, cycle products 28 percent, and liquefied petroleum gases 31 percent.

Refinery utilization.—Petroleum refineries utilized 2,822,694 thousand gallons of natural gasoline and allied products in 1944, an increase of 10 percent over 1943. Of this total, 65 percent was natural gasoline, 14 percent cycle products, and 21 percent liquefied gases and benzol. The demand for pentanes and butanes at refineries has increased rapidly because of their great value in high-octane gasoline production for the armed forces. Until a few years ago, treatment at refineries of liquids derived from natural gas was generally limited to minor fractionation and direct blending into finished products for sale to consumers. Modern procedure subjects the bulk of these materials to close fractionation or extensive chemical reorganization by synthesis or cracking before they become finished products, as such or by blending.

Distribution of natural gasoline and allied products in the United States, 1943-44, by months, in thousands of gallons

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1943													
Production:													
Natural gasoline.....	106,362	155,820	170,520	172,704	177,618	173,250	182,658	189,504	182,154	186,868	178,710	179,214	2,115,372
Cycle products.....	56,406	61,450	66,532	61,282	61,702	50,064	53,940	52,962	57,330	56,464	58,044	60,270	657,946
Liquefied petroleum gases.....	77,658	71,274	77,852	72,966	72,324	68,628	69,762	68,062	76,264	83,412	85,764	87,738	910,854
Liquefied refinery gases.....	14,070	14,616	15,288	14,364	14,166	12,054	16,674	13,692	13,944	11,004	13,818	17,178	170,898
Benzol.....	8,400	8,400	8,400	1,554	7,766	8,400	8,400	8,400	8,400	8,400	8,400	8,400	100,800
Decrease in all stocks.....						9,576	6,542	5,670	7,140	10,886	8,400	4,368	3,822
Used at refineries ¹	322,896	301,560	328,092	321,300	324,996	321,972	337,176	338,310	344,232	358,974	344,736	357,168	3,959,592
Sales of natural gasoline and cycle condensate to jobbers and retail outlets.....	181,314	181,692	206,004	209,412	218,274	218,738	216,762	230,706	235,746	233,688	216,972	225,918	2,570,316
Sales for fuel purposes.....	35,826	21,924	24,108	23,730	24,276	22,512	22,638	20,706	23,478	24,906	23,940	24,108	292,152
Liquefied petroleum gases.....	38,556	38,346	42,168	38,472	34,368	37,884	34,356	40,110	38,010	46,024	47,712	51,702	496,738
Liquefied refinery gases.....	14,070	14,616	15,288	14,364	14,166	12,054	16,674	13,692	13,944	11,004	13,818	17,178	170,898
Transfers of cycle products.....	4,536	4,368	4,578	6,090	6,090	5,764	4,536	4,788	6,566	6,888	6,216	6,678	66,108
Increase in all stocks.....	11,424	3,864	19,572	29,232	27,762	30,080	42,210	28,308	27,468	37,464	28,518	31,884	373,380
Exports, losses, and unidentified uses.....	37,170	36,750	16,884										
	322,896	301,560	328,092	321,300	324,996	321,972	337,176	338,310	344,232	358,974	344,736	357,168	3,959,592
1944													
Production:													
Natural gasoline.....	171,318	186,068	179,004	177,450	186,186	182,658	191,814	191,940	186,438	191,898	182,448	181,062	2,188,284
Cycle products.....	63,378	57,078	61,194	59,346	72,870	75,180	77,322	76,944	70,518	76,104	73,752	79,338	843,024
Liquefied petroleum gases.....	93,786	94,584	97,902	91,980	88,578	86,016	90,678	91,860	97,860	105,378	114,408	117,474	1,170,624
Liquefied refinery gases.....	16,464	16,540	12,306	13,734	12,222	10,060	13,104	14,028	16,708	17,388	19,572	23,688	183,834
Benzol.....	8,400	8,400	8,400	1,218	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400	100,800
Decrease in stocks.....	10,290	2,142	126				2,184	8,988	2,940			3,444	12,188
Used at refineries ¹	363,636	343,812	358,932	352,128	368,256	362,334	383,502	392,280	381,864	399,168	398,580	413,406	4,496,704
Sales of natural gasoline and cycle condensate to jobbers and retail outlets.....	226,044	194,208	225,834	210,504	218,316	228,018	238,630	256,628	243,568	252,840	256,578	252,336	2,832,964
Sales for fuel purposes.....	24,948	21,294	22,428	19,824	20,832	19,404	20,202	17,682	18,006	21,588	21,232	25,188	253,218
Liquefied petroleum gases.....	43,554	45,318	41,916	48,930	42,378	40,614	39,102	40,992	39,984	44,226	47,292	57,078	631,884
Liquefied refinery gases.....	16,464	16,540	12,306	13,734	12,222	10,060	13,104	14,028	16,708	17,388	19,572	23,688	183,834
Transfers of cycle products.....	7,392	6,006	6,720	6,592	6,838	7,140	6,972	7,392	6,644	6,628	5,400	6,838	76,482
Increase in stocks.....						9,366	1,722			798	7,308		
Exports, losses, and unidentified uses.....	45,234	61,446	49,728	52,884	59,304	55,356	45,192	56,638	58,464	56,700	41,118	49,306	631,072
	363,636	343,812	358,932	352,128	368,256	362,334	383,502	392,280	381,864	399,168	398,580	413,406	4,496,704

¹ Includes quantities run through pipe lines.
² Includes liquefied gases used in chemical manufacturing.

³ The quantities of liquefied refinery gases used for fuel are shown as the amount produced.
⁴ Subject to revision.

Natural gasoline and allied products utilized at refineries in the United States, 1943-44, by districts and months, in thousands of gallons

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
1943													
East Coast.....	3,612	1,050	3,444	2,520	1,722	294	4,158	5,628	336	1,302	1,428	5,166	30,660
Appalachian.....	1,806	1,722	1,680	1,470	1,176	1,218	1,290	1,176	1,554	1,806	1,428	1,764	18,060
Indiana, Illinois, Kentucky, etc.	21,504	27,468	21,504	24,906	27,258	23,898	25,242	28,056	31,038	29,778	26,754	27,594	315,000
Oklahoma, Kansas, and Missouri.....	14,742	18,186	16,128	17,682	15,750	17,514	17,262	18,480	17,976	20,328	20,706	22,344	217,068
Texas:													
Gulf Coast.....	58,086	49,098	71,988	68,964	73,500	68,376	67,326	67,788	70,896	69,216	63,504	66,738	795,480
Inland.....	18,186	29,190	28,350	29,568	28,014	33,238	29,022	33,054	35,448	33,726	30,576	30,450	360,822
Total Texas.....	76,272	78,288	100,338	98,532	101,514	103,614	96,348	100,842	106,344	102,942	94,080	97,188	1,156,302
Louisiana-Arkansas:													
Louisiana Gulf Coast.....	14,406	12,684	12,474	12,432	12,474	14,154	16,632	15,330	15,246	16,128	15,876	13,902	171,738
Arkansas and Louisiana Inland.....	5,250	4,158	4,032	5,418	4,158	4,326	5,418	4,956	4,956	4,536	4,410	5,418	57,036
Total Louisiana-Arkansas.....	19,656	16,842	16,506	17,850	16,632	18,480	22,050	20,286	20,202	20,664	20,286	19,320	228,774
Rocky Mountain.....	3,402	2,898	2,058	1,638	1,302	1,344	1,302	1,092	2,310	4,032	4,074	2,520	27,972
California.....	40,320	35,238	44,436	44,814	52,920	47,376	49,140	55,146	55,966	52,836	48,216	50,022	576,450
Total United States.....	181,314	181,692	206,094	200,412	218,274	213,738	216,762	230,706	235,746	233,088	216,972	225,918	2,570,316
1944													
East Coast.....	6,090	1,290	8,968	6,804	4,956	6,762	7,980	8,106	7,350	8,232	11,676	8,862	87,066
Appalachian.....	1,932	1,596	1,596	1,344	1,344	1,302	1,218	1,218	1,250	1,386	1,512	1,512	17,220
Indiana, Illinois, Kentucky, etc.	28,602	27,720	29,484	29,316	30,744	28,056	28,644	28,770	33,516	36,102	34,944	35,364	374,262
Oklahoma, Kansas, and Missouri.....	18,648	13,188	16,716	16,338	16,674	15,918	15,918	18,228	17,220	15,762	19,278	19,782	203,700
Texas:													
Gulf Coast.....	65,814	80,484	65,604	52,080	59,598	71,862	90,342	88,620	78,666	77,280	78,120	71,632	850,122
Inland.....	29,946	31,122	25,830	28,518	31,206	28,266	28,518	24,300	23,940	30,966	33,538	31,104	347,424
Total Texas.....	95,760	81,606	91,434	80,598	90,804	100,128	118,860	112,980	102,606	108,276	111,678	102,816	1,197,546
Louisiana-Arkansas:													
Louisiana Gulf Coast.....	14,826	14,280	15,456	16,590	15,246	17,178	15,918	17,808	16,632	17,640	16,800	14,364	192,738
Arkansas and Louisiana Inland.....	6,048	4,850	5,586	4,788	5,418	5,250	7,770	7,182	6,352	6,468	6,536	7,728	74,256
Total Louisiana-Arkansas.....	20,874	19,130	21,042	21,378	20,664	22,428	23,688	24,990	22,984	24,108	23,336	22,092	266,994
Rocky Mountain.....	1,560	3,528	2,982	2,730	2,730	4,200	5,064	4,998	4,968	5,022	4,116	5,670	48,258
California.....	52,218	46,300	53,562	50,464	60,400	49,224	57,640	56,238	53,424	50,022	49,938	56,238	627,648
Total United States.....	226,044	194,208	225,834	210,504	218,316	228,018	258,930	255,528	243,558	252,840	256,578	252,336	2,822,094

1 Subject to revision.

Percentage of natural gasoline and allied products in refinery gasoline in the United States, 1940-44, by districts

Year	East Coast	Appalachian	Indiana, Illinois, Kentucky	Oklahoma, Kansas, Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas and Louisiana Inland	Rocky Mountain	California	Total
1940.....	2.0	1.6	4.5	8.0	16.6	4.4	1.7	3.3	4.5	15.7	6.6
1941.....	2.3	1.9	5.3	6.6	17.6	5.6	3.7	6.1	4.4	16.1	7.1
1942 ¹	1.4	2.1	5.8	6.3	16.0	13.9	13.1	11.6	4.8	16.7	9.6
1943 ¹	1.1	1.9	6.0	8.6	21.2	14.2	18.3	12.9	4.0	15.0	10.3
1944 ^{1,2}	2.3	1.7	6.3	7.1	17.8	11.6	12.6	16.5	5.7	13.6	9.3

¹ Not comparable with prior years because relatively more liquefied petroleum gas is included.

² Subject to revision.

"Direct" sales.—Sales of natural gasoline and cycle products to jobbers and retailers continued the decline that has characterized the war period. The urgent demand from refiners to meet their quotas of military gasolines under the war program expanded to record volume in 1944 and tended to further restrict supplies available to distributors. Motor-fuel rationing also may have affected adversely the volume of business available to dealers.

Sales of liquified gases for fuel in 1944 were 9 percent greater than in 1943 in spite of restrictions upon civilian usage and equipment. Essential industrial and military uses were materially higher than in 1943. The growth of normal fuel markets for liquefied gases has been retarded by war needs.

Exports.—Foreign shipments continued at an abnormally low level in 1944, although 21 percent above 1943, reflecting heavy domestic demand and the war-induced scarcity of shipping. Of the total light products exported, 28.2 million gallons were classified as natural gasoline and 14.5 million as liquefied petroleum gases. The total value of exports was \$2,865,827 in 1944 and \$2,168,407 in 1943.

Of the total shipments of 42,696 thousand gallons, the following quantities were distributed to the principal countries of destination: Canada, 34,504 thousand gallons, Mexico, 7,749, and Portugal, 64.

STOCKS

Total stocks of products of the natural-gasoline industry declined during 1944 from 190,722 thousand gallons on January 1 to 178,584 thousand gallons at the year end. The relative stability of stocks throughout the year is indicated by their extreme range of 16,800 thousand gallons compared with 41,874 thousand in 1943.

Reversing the large gain in 1943 (23 million gallons), stocks at refineries declined 13 million gallons. Those at plants and terminals increased to a peak in May 1944 and were drawn down in later months to end the year slightly above the level of January 1, 1944. Stocks at California refineries were reduced 9.5 million gallons during 1944 and those on the East coast 7.7 million gallons to a very low level. Material declines occurred also in Wyoming and the Louisiana Gulf district. Stocks in Texas and Oklahoma rose moderately.

Trends in stocks by grades in 1944 were similar to 1943. Natural gasoline fell 15.7 million gallons; cycle products and liquefied gases rose 2.1 and 1.4 million gallons, respectively.

Stocks of natural gasoline and allied products in the United States, 1943-44, by months, in thousands of gallons

Date	Natural gasoline	Cycle products	Liquefied petroleum gases	Total
1943				
Jan. 1.....	157,374	13,524	23,646	194,544
Jan. 31.....	167,244	15,876	22,848	205,968
Feb. 28.....	167,748	17,640	24,444	209,832
Mar. 31.....	178,164	18,648	32,592	229,404
Apr. 30.....	174,594	16,086	37,170	227,850
May 31.....	173,964	16,548	36,582	227,094
June 30.....	168,126	16,548	32,844	217,518
July 31.....	160,566	13,734	36,876	211,176
Aug. 31.....	153,384	13,818	38,304	205,506
Sept. 30.....	139,944	15,918	42,504	198,366
Oct. 31.....	127,470	14,994	45,066	187,530
Nov. 30.....	132,006	14,994	48,090	195,090
Dec. 31.....	130,410	15,288	45,024	190,722
1944¹				
Jan. 1.....	130,410	15,288	45,024	190,722
Jan. 31.....	124,908	13,902	41,622	180,432
Feb. 28.....	121,296	13,482	43,512	178,290
Mar. 31.....	121,170	12,810	44,184	178,164
Apr. 30.....	123,438	11,046	42,462	176,946
May 31.....	129,024	17,094	40,194	186,312
June 30.....	128,310	19,950	39,774	188,034
July 31.....	127,134	16,128	42,588	185,850
Aug. 31.....	115,090	17,304	44,478	176,862
Sept. 30.....	109,328	16,128	48,468	173,922
Oct. 31.....	114,324	16,002	44,394	174,720
Nov. 30.....	114,954	19,740	47,334	182,028
Dec. 31.....	114,702	17,430	46,452	178,584

¹ Revised figure.

² Subject to revision.

TECHNOLOGIC DEVELOPMENTS

Cycle plants.—The first cycle plant in California went on stream in June 1944 in the Paloma field. At Erath, La., the largest cycle plant thus far constructed began operating about May 1, almost doubling the rate of light-products production in the State. Enlargements to the Katy, Tex., cycle plant in 1944 and 1945 may increase its capacity above that of the Erath plant.

The more complete cycle plants are verging upon the status of a refinery in that they produce a considerable volume and variety of finished products of high grade. Chemical plants on the Gulf coast are providing a new market for over 5,000 barrels per day of liquefied gases produced at cycle plants.

Yields.—The average yield of all products at natural-gasoline and cycle plants was 1.22 gallons per thousand cubic feet in 1943, unchanged from 1942. Yields declined in eight States in most of which unit recoveries are characteristically low because a large proportion of the gas treated originates in gas fields and is stripped preparatory to entering gas pipelines. Of the six States in which yields increased, five are above the national average in recoveries because most of the gas treated at plants is produced in oil fields. Louisiana is an exception because of the domination of cycle-plant operations in the field of light-products production from natural gas.

Production by processes.—The total number of operating plants in 1943 was 642, a net loss of 25 from 1942, including 19 of the compression type. In all, 21 compression plants were shut down and 2 commenced operating. Eight absorption plants were added to the active list, and 11, of which 6 were in Oklahoma, ceased operations. Two

new cycle plants were put in operation in Texas in 1943. . The indicated decline of 3 in the total number of cycle plants operating results from elimination of 5 small plants that had functioned, chiefly as separators, in condensate-type fields.

Owing to a gain in Texas, the compression plants produced almost 7 percent of the total output in 1943 compared with less than 6 percent in 1942, and absorption plants produced 73 percent compared with 74 percent in 1942. The share of cycle plants was 20 percent in both years, and production by the charcoal method declined to a negligible fraction of 1 percent. Production of liquefied petroleum gases was reported at 191 plants in 1942 and at 204 in 1943.

Vapor pressures.—The average vapor pressure of natural gasoline produced east of California was 20.6 pounds in 1944. This average had risen from a low of 19.3 pounds in 1940 to 21.2 pounds in 1943.

*Natural gasoline and allied products produced in the United States in 1943, by States and by methods of manufacture*¹

State	Number of plants operating				Production (thousands of gallons)			
	Com- pres- sion ²	Absorp- tion ^{3,4}	Char- coal	Cycling ⁵	Com- pres- sion ²	Absorp- tion ^{3,4}	Char- coal	Cycling ⁵
Arkansas.....		10				56, 837		
California.....	1	84			48	693, 284		
Colorado.....						468		
Illinois.....	29	7			1, 266	184, 221		
Kansas.....	2	11			1, 483	83, 723		
Kentucky.....	2	3			1, 063	42, 254		
Louisiana.....	2	26		2	2, 730	137, 115		166, 217
Michigan.....	2	1			392	834		
Montana.....		1				4, 664		
New Mexico.....	2	7			2, 032	78, 973		
New York.....	1				12			
Ohio.....	2	7	1		3	6, 423	69	
Oklahoma.....	24	81			25, 376	396, 937		
Pennsylvania.....	64	13			1, 679	15, 855		
Texas.....	31	114		31	170, 447	904, 591		570, 993
Utah.....						666		
West Virginia.....	51	20	4		21, 957	73, 730	2, 255	
Wyoming.....	2	4			17, 749	17, 726		
Total: 1943....	215	389	5	33	246, 237	2, 698, 301	2, 324	737, 210
1942.....	234	392	5	36	204, 792	2, 588, 124	2, 940	703, 668

¹ Figures for 1944 not yet available.

² Includes 17 plants manufacturing liquefied petroleum gases.

³ Includes combination of absorption process with compression and charcoal processes.

⁴ Includes 167 plants manufacturing liquefied petroleum gases.

⁵ Includes 20 plants manufacturing liquefied petroleum gases.

⁶ Drip gasoline.

Technical trends.—Emphasis continues upon the production at plants of greater quantities and variety of specific products for specific needs—in other words, an increase in the scope of liquid processing at larger, more efficient plants. The resulting increase in plant investment per gallon of output is justified on the basis of the higher unit prices commanded by products that meet rigid specifications than can be realized from the broad, relatively raw fractions.

Absorption pressures currently range from two to five times those in general use before the war, and recovery of butanes is approximately double the old average, approaching 100 percent in the most efficient plants. The recovery of propane is also notably higher at many plants but is still far below the total potential supply because of economic limitations. As only about one-third of the plants in the

natural-gasoline industry are equipped to segregate liquefied gases, this phase of the business appears to be susceptible of significant further development under favorable economic conditions. Rapid expansion in the use of propane for chemical and fuel purposes after the war is anticipated by many in the industry.

Greater plant investment is related chiefly to the heavy equipment required for higher operating pressures, more elaborate facilities for fractionation, synthetic and other chemical processing; and circulation of absorption oil. Storage vessels for products of widely different physical characteristics must also be provided.

Some of the plants associated with pressure maintenance or repressuring in oil fields should occupy a strong position because, among other factors, some of their costs may legitimately be charged to oil-producing operations.

LIQUEFIED PETROLEUM GASES; SALES SURVEY

The percentage rate of gain in annual sales of liquefied petroleum gases declined from 27 percent in 1942 to 15 percent in 1943; however, it turned sharply upward in 1944 when comparative deliveries of 905,600,000 gallons were 34 percent above the 1943 total of 675,233,000 gallons. The 1944 survey of the Bureau of Mines was extended to cover material delivered for synthetic rubber components, and when this additional demand is included the 1944 quantity expands to 1,061,809,000 gallons—a total realized in spite of wartime regulations, equipment and transportation difficulties, and ever-increasing diversions to satisfy the demand for aviation-grade motor fuel and possible because of greatly increased production of liquefied petroleum gases from both old and new plants.

Sales of liquefied petroleum gases in the United States, 1937-44, in thousands of gallons

Year	Butane	Propane	Butane-propane mixtures	Pentane	Total	
					Quantity	Percent of increase over preceding year
1937.....	45,399	46,474	46,694	2,833	141,400	32.6
1938.....	52,768	54,130	56,050	2,253	165,201	16.8
1939.....	71,351	79,323	69,020	3,886	223,580	35.3
1940.....	77,056	109,216	123,348	3,836	313,456	40.2
1941.....	112,244	126,969	219,252	4,387	462,852	47.7
1942.....	128,560	150,511	301,917	4,452	585,440	26.5
1943.....	140,122	218,273	312,683	4,155	675,233	15.3
1944 ¹	277,240	335,377	449,192	(²)	1,061,809	57.3
1944 ³	132,870	323,848	448,882	(⁴)	905,600	34.1

¹ Subject to revision. ² Includes material delivered for synthetic rubber components. ³ Without synthetic rubber components for comparison with 1943. ⁴ Not available.

Petroleum refineries, gasoline plants, and cycle plants cooperating in the 1944 survey reported 156,209,000 gallons of liquefied petroleum gases delivered for synthetic rubber components. Most of this material—144,370,000 gallons or 92 percent—was indicated as butane or related gases, and all of it was reported for areas east of California. The above quantity of liquefied petroleum gases delivered for the manufacture of synthetic rubber is below the 1944 total released by

the Petroleum Administration for War as estimated from its industry survey for the same areas—districts 1 to 4. The Bureau of Mines survey was based on actual deliveries; furthermore, reporting companies were asked to limit items to liquefied gases, whereas the industry survey covered material in a liquid as well as a gaseous state.

Omitting sales of material reported for synthetic rubber components so that 1943 and 1944 items will be on a comparative basis, all principal uses of liquefied petroleum gases showed greater percentage gains in 1944 than in 1943, except the demand for industrial fuel, which expanded at a lesser rate than in 1943, and "All other uses," which registered a loss in 1944. The percentage increases in 1944 were quite different from those in 1943, when the demand for industrial fuel showed a larger gain and other principal uses smaller rates of expansion than in 1942.

Sales of liquefied petroleum gases for domestic use increased by 29 percent from 339,380,000 gallons in 1943 to 438,552,000 in 1944. The important gain in 1944 indicates that the downward trend in the annual expansion rate (65 percent gain in 1941, 36 percent in 1942, and 13 percent in 1943) has been arrested and that distributors are finding ways to overcome appliance and transportation difficulties in order to market a growing production. Manufactured-gas companies are using an ever larger amount of liquefied petroleum gases for direct distribution or for stand-by gas, and they increased their purchases by 27 percent from 37,519,000 gallons in 1943 to 47,768,000 in 1944. Deliveries of liquefied petroleum gases for industrial fuel rose from 149,429,000 gallons in 1943 to 163,036,000 in 1944—a 9-percent gain in contrast to a 31-percent expansion in 1943 over 1942. The lower rate of increase in 1944 reflects equipment and transportation difficulties and also the diversion of butane for other purposes.

A greatly stepped-up use of liquefied petroleum gases as raw material for chemical manufacturing is indicated in sales of 151,985,000 gallons for this purpose in 1944—a quantity nearly triple the 1943 demand of 55,356,000 gallons. Part of this growth reflects expansion under war conditions; however, some of it is due to more complete reporting of this demand in 1944 than in 1943. Liquefied petroleum gases delivered for internal-combustion-engine fuel increased from 87,834,000 gallons in 1943 to 101,760,000 in 1944—a 16-percent gain compared with a 7-percent increment in 1943 over 1942.

Restrictions on butane equipment and its diversion for the manufacture of synthetic rubber and high-octane motor fuel have tended to lower the relative proportion marketed for fuel purposes. The butane item in the annual sales has dropped steadily from 24 percent of the total in 1941 to 15 percent in 1944, and most of this decline occurred in 1944 when nonfuel demands for butane approached peak levels. The fuel load has shifted to propane and butane-propane mixtures, and relative proportions for these gases have increased in recent years. The share of propane in the annual total has mounted from 27 percent in 1941 to 36 percent in 1944, whereas "mixtures" have expanded from 47 to 50 percent of the total in the same period. The rise in the relative proportions for these gases during the several years has not been constant, however, as the percentage share for propane declined in 1942, when there was an unusual increase in deliveries of butane-propane mixtures. Then the percentage of "mixtures" in the total dropped in 1943, to be followed by a gain in 1944. Pen-

tane reported in the annual survey has made up less than 1 percent of the total in recent years, so this "gas" was dropped from the 1944 schedule as being relatively unimportant. Furthermore, some authorities have contended that, strictly speaking, pentane should not be included as a liquefied petroleum gas.

Deliveries of butane declined 5 percent, from 140,122,000 gallons in 1943 to 132,870,000 in 1944, as restrictions governing certain uses were enforced and larger quantities were diverted for raw material to the synthetic rubber and chemical industries. Shrinkage in the consumption of butane as a domestic fuel, first noticed in 1943 with a 2-percent decline, was strongly evident in 1944, when sales of 27,565,000 gallons were 38 percent below the 1943 total of 44,255,000 gallons. The use of butane as motor fuel, which is greatly limited under present conditions, has declined from 14,870,000 gallons in 1942 to 9,895,000 in 1943 and to 4,030,000 in 1944. Sales of butane for industrial fuel, which showed some expansion in 1942 and 1943, declined by 6 percent from 56,143,000 gallons in 1943 to 52,890,000 in 1944, although equipment for the use of industrial plants is not limited. Manufactured-gas companies, under no restrictions regarding equipment for the handling of butane and endeavoring to take care of more customers and heavier service loads, purchased 24,900,000 gallons of butane in 1944 or 14 percent over 1943 requirements of 21,829,000 gallons. The use of butane as raw material in the manufacture of chemicals showed a strong upward trend in 1944, and the demand of 23,475,000 gallons was far above the 1943 total of 7,972,000 gallons.

Changes in the principal demands for butane stand out when reviewed with respect to the percentage of total sales. Butane reported for domestic fuel has declined from 35 percent of all demands in 1942 to 32 percent in 1943 and down sharply to 21 percent in 1944. The proportion of butane consumed as motor fuel has shown a similar downward trend from 12 percent of all requirements in 1942 to 3 percent in 1944. Butane credited as industrial fuel has remained fairly constant at about 40 percent of all principal uses in recent years, but the percentage share sold to manufactured-gas companies of 19 percent in 1944 is double the 1942 proportion. The percentage of butane sales reported for chemical raw material mounted sharply from 6 percent in 1943 to 18 percent of the 1944 total.

That a large share of the fuel load formerly carried by butane has been shifted to propane under present conditions is evident in the 48-percent gain in sales of propane from 218,273,000 gallons in 1943 to 323,848,000 in 1944. All principal uses of propane showed outstanding gains in 1944. Deliveries for domestic consumption increased by 34 percent from 124,670,000 gallons in 1943 to 166,947,000 in 1944. It should be noticed, however, that as propane is diverted to other uses, the share credited to household consumption has declined from 75 percent of the total demand in 1942 to 57 percent in 1943 and then to 52 percent in 1944. Industrial plants have turned strongly to propane for fuel in place of butane, and the demand has expanded from 20,601,000 gallons in 1942 to 73,698,000 in 1943 and to 90,674,000 in 1944. Manufacturing plants again used more propane than butane in 1944 as they did for the first time in 1943. Furthermore, propane delivered for industrial fuel made up 28 percent of the total for all uses in 1944 against a 34-percent share in 1943. Requirements for propane by

manufactured-gas companies increased from 8,117,000 gallons in 1943 to 17,103,000 in 1944; however, the 1944 item for this particular use was still below the corresponding demand for butane. Sales of propane for raw material to chemical manufacturing plants jumped from 4,455,000 gallons in 1943 to 40,666,000 in 1944; however, it is believed that the 1943 demand was not fully reported. Propane used as fuel in internal-combustion engines advanced from 4,592,000 gallons in 1943 to 6,650,000 in 1944, and the latter quantity is above the corresponding butane item for the first time in 1944.

Deliveries of butane-propane mixtures in 1943 were little above the 1942 total; but in 1944 when there were difficulties in obtaining enough butane for all purposes there was a general turning to both propane and to butane-propane mixtures for fuel and for raw material in the chemical industry. Reported sales of "mixtures" increased by 44 percent from 312,683,000 gallons in 1943 to 448,882,000 in 1944, and the expansion was limited largely to domestic-fuel and chemical-manufacturing demands. More than half (54 percent in both 1943 and 1944) of the butane-propane mixtures is sold for domestic fuel, and requirements increased by 44 percent from 169,818,000 gallons in 1943 to 244,040,000 in 1944. "Mixtures" delivered as raw material to chemical plants made up 20 percent of the 1944 total (13 percent in 1943), and the quantity more than doubled from 39,584,000 gallons in 1943 to 87,844,000 in 1944. Liquefied petroleum gases used as fuel in internal-combustion engines are usually a mixture of butane and propane, and the demand has expanded steadily in spite of restrictions. "Mixtures" delivered for engine fuel constituted 20 percent of all demands in 1944, and the total of 91,080,000 gallons was 24 percent over 1943 deliveries of 73,344,000 gallons. Industrial plants turned strongly to propane for fuel in 1943 and 1944, and as a result their purchases of butane-propane mixtures remained at the same level—19,472,000 gallons in 1944 and 19,474,000 in 1943. Manufactured-gas companies have increased their demand for both butane and propane in recent years; however, their requirements for "mixtures" have dropped from 7,532,000 gallons in 1943 to 5,765,000 in 1944.

Sales of liquefied petroleum gases in the United States, 1943-44, by uses, methods of transportation, and regional distribution, in thousands of gallons

	Butane	Propane	Butane-propane mixtures	Pentane	Total	
					Quantity	Percent
1943						
By uses:						
Domestic.....	44,255	124,670	169,818	637	339,380	50.3
Gas manufacturing.....	21,829	8,117	7,532	41	37,519	5.6
Industrial fuel.....	56,143	73,698	19,474	114	149,429	22.1
Chemical manufacturing.....	7,972	4,455	39,584	3,345	55,356	8.2
Internal-combustion-engine fuel.....	9,895	4,592	73,344	3	87,834	13.0
All other uses.....	28	2,741	2,931	15	5,715	.8
	140,122	218,273	312,683	4,155	675,233	100.0
Percent of total	20.8	32.3	46.3	.6	100.0	
By methods of transportation:						
Bulk.....	139,454	148,453	307,566	3,990	599,463	88.8
Cylinders and drums.....	668	69,820	5,117	165	75,770	11.2
	140,122	218,273	312,683	4,155	675,233	100.0

Sales of liquefied petroleum gases in the United States, 1943-44, by uses, methods of transportation, and regional distribution, in thousands of gallons—Continued

	Butane	Propane	Butane-propane mixtures	Pentane	Total	
					Quantity	Percent
1944^{1,2}						
By uses:						
Domestic.....	27,565	166,947	244,040	(1)	438,552	41.3
Gas manufacturing.....	24,900	17,103	5,765		47,768	- 4.5
Industrial fuel.....	52,890	90,674	19,472		163,036	15.4
Synthetic rubber components.....	144,370	11,529	310		156,209	14.7
Chemical manufacturing.....	23,475	40,666	87,844		151,985	14.3
Internal-combustion-engine fuel.....	4,030	6,650	91,080	(1)	101,760	9.6
All other uses.....	10	1,808	681		2,499	0.2
	277,240	335,377	449,192		1,061,809	100.0
Percent of total.....	26.1	31.6	42.3		100.0	-----
Regional distribution:						
Pacific Coast area.....	18,693	47,418	102,455	(1)	168,566	15.9
All other areas.....	258,547	287,959	346,737		893,243	84.1
	277,240	335,377	449,192		1,061,809	100.0
1944^{1,3}						
By uses:						
Domestic.....	27,565	166,947	244,040	(1)	438,552	48.4
Gas manufacturing.....	24,900	17,103	5,765		47,768	5.3
Industrial fuel.....	52,890	90,674	19,472		163,036	18.0
Chemical manufacturing.....	23,475	40,666	87,844		151,985	16.8
Internal-combustion-engine fuel.....	4,030	6,650	91,080		101,760	11.2
All other uses.....	10	1,808	681	(1)	2,499	0.3
	132,870	323,848	448,882		905,600	100.0
Percent of total.....	14.7	35.7	49.6		100.0	-----
Regional distribution:						
Pacific Coast area.....	18,693	47,418	102,455	(1)	168,566	18.6
All other areas.....	114,177	276,430	346,427		737,034	81.4
	132,870	323,848	448,882	(1)	905,600	100.0

¹ Subject to revision.

² Includes material delivered for synthetic rubber components.

³ Without synthetic rubber components for comparison with 1943.

⁴ Not available.

The relative proportions of the different gases delivered for the principal uses have varied greatly in the war years. Sales of butane for domestic fuel have declined from 15 percent of the total in 1941 to 6 percent in 1944—a shrinkage due to present restrictions and the expanding requirements for butane as a raw material. The relative amount of propane in the domestic-use item has also declined, dropping from 44 percent in 1941 to 37 percent in 1943; however, there was a slight upward turn in the quantity to 38 percent of the total demand in 1944. The declining share of the household fuel formerly credited to butane and propane has been shifted to butane-propane mixtures, and these have increased from 40 percent of the domestic total in 1941 to 56 percent in 1944.

Relatively more butane and propane and less butane-propane mixtures are sold to manufactured-gas companies at present than in former times; however, the percentage shares show fluctuations from year to year. The butane proportion dropped from 48 percent in 1941 to 40 percent in 1942 and then rose to 58 percent in 1943. It did not remain at this high level, receding to a 52-percent share in 1944. The percentage of propane delivered to manufactured-gas companies dipped from 27 percent in 1941 to 16 percent in 1942 and then turned upward to a 22-percent share in 1943 and 36 percent in

1944. The relative quantity of butane-propane mixtures credited to gas companies has diminished steadily from the unusually high proportion of 45 percent in 1942 to 12 percent of the total in 1944.

Liquefied petroleum gases used for industrial fuel have shifted strongly to propane and away from both butane and butane-propane mixtures in recent years. The propane proportion has "sky-rocketed" from about an 18-percent share in 1941 and 1942 to 49 percent of the total in 1943 and 56 percent in 1944. The butane percentage for industrial fuel has not dropped as drastically as that for "mixtures." The butane share has declined from 47 percent of the demand in 1941 to 32 percent in 1944, whereas that for butane-propane mixtures has shrunk from 36 percent of total requirements to 12 percent in the same interval.

Relatively more butane-propane mixtures are reported for chemical raw material than the other liquefied petroleum gases; however, the percentage for "mixtures" has declined sharply from 89 percent of the total in 1941 to 58 percent in 1944. Butane delivered to chemical plants has increased from less than 1 percent of the total in 1941 to 15 percent in 1944, but the proportion of propane has advanced intermittently from 4 percent of the demand in 1941 to 27 percent in 1944. Pentane satisfied about 7 percent of the chemical demand for liquefied petroleum gases from 1941 to 1943.

Liquefied petroleum gases used as fuel in internal-combustion engines have been predominantly butane-propane mixtures, and the relative proportion has increased as the demand for butane for raw material has mounted. The percentage of "mixtures" for this particular use has advanced from 70 percent of the item in 1941 to 90 percent in 1944, while the butane total has dropped from 28 percent of the requirements in 1941 to 4 percent in 1944. Very little propane is sold for internal-combustion-engine fuel, yet the quantity has increased from 2 percent of the total in 1941 to 7 percent in 1944.

The American Gas Association has reviewed the distribution of liquefied petroleum gases by manufactured-gas companies in 1944 as follows:

At the end of 1944, liquefied petroleum gas was being delivered through mains to consumers in 224 communities in 32 States by 101 companies supplying 94,660 consumers.

Butane-air gas with heating value ranging from 520 to 1,600 B. t. u. per cu. ft. was supplied to 166 communities in 31 States. A mixture of undiluted butane and propane gas with a heating value of 2,800 to 3,000 B. t. u. per cu. ft. was supplied to 18 communities in Arizona, California and New Mexico. Undiluted propane gas with a heating value of 2,550 B. t. u. per cu. ft. was supplied to 40 communities in Maryland, Minnesota, New Jersey, North Dakota, Virginia and Wisconsin.

Partly estimated totals covering sales of liquefied petroleum gases in the Pacific Coast area—California, Oregon, Washington, Arizona, and Nevada—indicate a demand of 168,566,000 gallons in 1944, a 23-percent gain over 1943 deliveries of 136,601,000 gallons. Liquefied petroleum gases marketed on the Pacific coast constituted 19 percent of the national total in 1944 and 20 percent in 1943. Distributors in "all other areas" reported sales of 737,034,000 gallons of liquefied petroleum gases in 1944 compared with a market for 538,632,000 in 1943—an increase of 37 percent. An additional quantity of 156,209,000 gallons of liquefied petroleum gases was diverted to plants east of California in 1944 for the manufacture of synthetic rubber.

CARBON BLACK

By F. S. LOTT AND H. BACKUS

SUMMARY OUTLINE

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SUMMARY

The demand for carbon black reached unprecedented proportions in 1944, exceeding production by 135,570,000 pounds. As a result, producers' stocks were reduced to 69,243,000 pounds on December 31, the lowest level since 1928. Further drafts upon these stocks in the early months of 1945 depleted them almost to the vanishing point in spite of an increasing production rate.

The major factor in demand was the rapid rise of synthetic rubber production and processing that followed the development of successful techniques under the compulsion of war necessity. This achievement in production made possible a record consumption in 1944 of rubber which contributed vitally to the prosecution of the war in a growing variety of applications. The effect upon the demand for carbon black was magnified by the peculiar properties of synthetics, which require for highest efficiency much more carbon black per pound than does natural rubber. Deliveries to rubber companies were 56 percent above 1943 and accounted for 95 percent of total domestic sales. They amounted to over 950 pounds per ton of rubber of all types consumed in 1944.

Salient statistics of carbon black produced from natural gas in the United States, 1940-44

	1940	1941	1942	1943	1944
Number of producers reporting.....	22	21	21	21	22
Number of plants.....	51	49	50	54	54
Quantity produced:					
By States and districts:					
Louisiana.....pounds..	55, 610, 000	78, 050, 000	90, 353, 000	109, 609, 000	160, 019, 000
Texas:					
Panhandle district.....do.....	423, 908, 000	415, 001, 000	380, 536, 000	345, 447, 000	401, 556, 000
Rest of State.....do.....	55, 987, 000	65, 211, 000	54, 353, 000	61, 898, 000	99, 606, 000
Total Texas.....do.....	479, 895, 000	480, 212, 000	434, 889, 000	407, 345, 000	501, 162, 000
Other States.....do.....	33, 287, 000	35, 803, 000	48, 764, 000	76, 467, 000	140, 679, 000
Total United States.....do.....	568, 792, 000	594, 065, 000	574, 006, 000	563, 421, 000	801, 860, 000

Salient statistics of carbon black produced from natural gas in the United States, 1940-44—Continued

	1940	1941	1942	1943	1944
Quantity produced—Continued.					
By processes:					
Contact processes ¹ pounds..	497,026,000	492,857,000	428,665,000	379,923,000	414,676,000
Furnace processes.....do.....	71,766,000	101,208,000	145,341,000	213,498,000	387,184,000
Stocks held by producers Dec. 31:					
Contact types.....pounds..	(²)	(²)	(²)	196,913,000	58,036,000
Furnace types.....do.....	(²)	(²)	(²)	8,302,000	11,207,000
Total.....do.....	169,587,000	118,847,000	242,755,000	205,215,000	69,243,000
Losses.....do.....	223,000	61,000	167,000	1,661,000	402,000
Quantity sold:					
Domestic deliveries—					
To rubber companies.....do.....	310,179,000	439,502,000	295,947,000	473,473,000	738,029,000
To ink companies.....do.....	24,159,000	28,198,000	19,233,000	23,530,000	24,479,000
To paint companies.....do.....	6,806,000	5,840,000	3,616,000	3,945,000	5,315,000
For miscellaneous purposes.....do.....	11,012,000	23,039,000	15,500,000	23,440,000	12,655,000
Total domestic deliveries.....do.....	352,156,000	496,579,000	334,296,000	524,388,000	780,478,000
Export.....do.....	177,618,000	148,165,000	115,635,000	104,912,000	156,952,000
Total sold.....do.....	529,774,000	644,744,000	449,931,000	629,300,000	937,430,000
Value (at plants) of carbon black produced:					
Total.....	\$16,510,000	\$19,341,000	\$19,547,000	\$20,248,000	\$29,411,000
Average per pound.....cents.....	2.90	3.26	3.41	3.41	3.67
Estimated quantity of natural gas used.....M cubic feet.....	368,802,000	365,377,000	335,533,000	315,562,000	355,770,000
Average yield of carbon black per M cubic feet.....pounds.....	1.54	1.63	1.71	1.88	2.20
Average value of natural gas used per M cubic feet.....cents.....	1.00	1.13	1.29	1.47	1.62

¹ Principally channel.

² Figures not available.

Total production of carbon black increased 35 percent in 1944 over 1943 and exceeded the former peak in 1941 by 35 percent. (See fig. 1.) Output by contact processes reversed a down-trend of 3

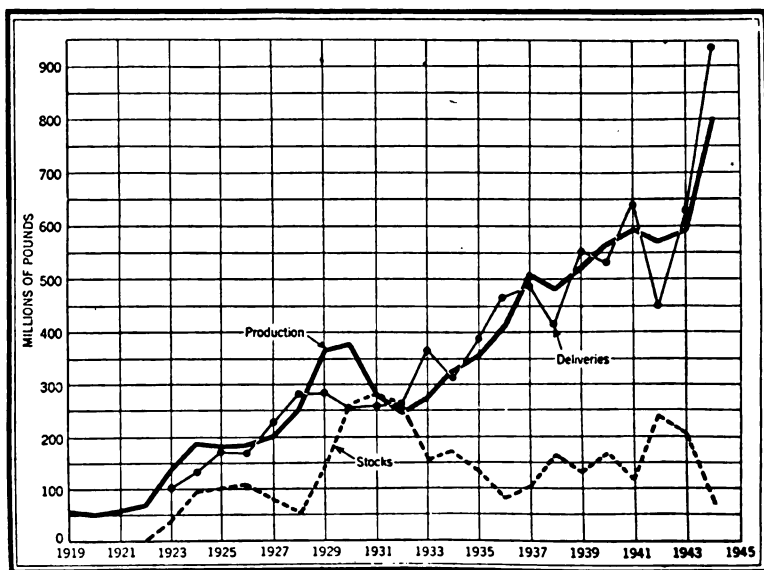


FIGURE 1.—Production, stocks, and deliveries of carbon black, 1919-44.

years' duration to gain 9 percent over 1943; and that by furnace processes was 81 percent above 1943, continuing the consistent growth since 1938.

For the first time since the outbreak of war, exports increased sharply (50 percent) in 1944 to 156,952,000 pounds.

Summary of statistics for carbon black produced from natural gas in the United States, 1940-44

Year	Production (thousands of pounds)	Value (thousands of dollars)	Stocks at end of year (thousands of pounds)	Sales (thousands of pounds)		Average yield (pounds per M cubic feet of gas)
				Domestic	Export	
1940.....	568, 792	16, 510	169, 687	352, 154	177, 618	1. 54
1941.....	594, 065	19, 341	118, 847	496, 579	148, 165	1. 63
1942.....	574, 006	19, 847	242, 755	334, 296	115, 636	1. 71
1943.....	593, 421	20, 248	205, 215	524, 388	104, 912	1. 88
1944.....	801, 860	29, 411	69, 243	780, 478	156, 952	2. 20

CURRENT AND POSTWAR OUTLOOK

Although the rate of production of carbon black of rubber grades in the first quarter of 1945 was about 31 percent higher than a year earlier, the consistent excess of demand over production caused the War Production Board to take emergency action to curtail consumption increase production. In February the permissible quantity of carbon black in rubber was reduced an average of about 10 percent below general practice to conserve several million pounds a month. Arrangements were made in March to increase the output of some active plants by enrichment of gas with propane and gasoline. Higher price ceilings were allowed on added production of channel and furnace black under emergency high-cost conditions. Other steps, including assignment of top priorities on materials and manpower, were taken to expand productive capacity as soon as possible.

The military victory in Europe was followed in May 1945 by a cut-back of rubber requirements for the Army. This development and the rapid rise in carbon-black output brought supply and demand into close balance for the first time in about 2 years. Projected requirements for synthetic rubber of 1 million long tons in 1945 and 1.2 million in 1946, as announced by the Rubber Reserve Company, indicate that little increase above current rates of production (296,045 long tons in the first 4 months of 1945) will be required. On the other hand, further large gains in carbon-black production are scheduled for later months in 1945 as new facilities come into operation which may raise the rate above 110 million pounds per month. It may be expected, therefore, that the supply of carbon black through 1946 will suffice for domestic requirements for rubber and other established uses and for a material increase in exports over the monthly average in 1944. The emergency restrictions placed in February upon carbon black "loading" in rubber, as mentioned above, were canceled early in June.

From a longer range view, many conditions that will influence the demand for carbon black during the 5 years following the war are not predictable. Some of the fundamentals that have been widely studied and discussed and an appraisal of the rapid developments of the past

2 years may serve as the basis for a speculative analysis with some merit.

The annual world absorption of crude rubber in the period 1936-40 averaged almost 1.1 million long tons, of which the United States took 60 percent in 1940. Sales of carbon black in this period by United States manufacturers, to rubber companies and for export, averaged approximately 415 pounds per ton of rubber absorbed. As recent practice has been to add more carbon black per ton of natural rubber compounded, an average of 460 pounds per ton (the 1939-40 experience) is considered more representative of present and prospective conditions.

A number of estimates of postwar rubber consumption have been published which indicate that about 1.5 million tons per year will be used, exclusive of reclaimed rubber. This quantity approximates a projection of the long term trend in rubber consumption and therefore assumes a continuation of growth at a rate comparable with the average in the 1925-40 period.

In order to estimate the amount of carbon black to be used with rubber, some measure of the proportion of synthetic to natural types that may be compounded is necessary. Although it is recognized that a high factor of error is inherent in any forecast of the synthetic rubber industry, the following assumptions appear reasonable on the basis of fragmentary information at present available. In making them, emphasis has been placed upon the probable economic and strategic position of synthetics. No attempt is made to appraise variants that may be introduced by future national or international policies. In the first year following liberation of the rubber-producing areas, consumption of about 800,000 tons of synthetic rubber is probable, the total declining in the following 4 years to a rate of about 400,000 tons, to average 600,000 tons for the period.

Technical advance is steadily improving the cost and quality factors upon which synthetic rubber may depend in postwar competitive markets. In May 1944 the most efficient plant produced GR-S (Buna-S) rubber at a cost of 14 cents a pound, including plant amortization over a 10-year period,¹ and trade sources indicate that a cost of about 10 cents may be possible under peacetime conditions. Important new techniques, such as those involving continuous polymerization of rubber and the addition of carbon black to liquid latex before coagulation, accomplish cost reductions and improve the quality of the product. The extent to which ingenuity may alter the economics of synthetic rubber in a given period can only be conjectured. However, a rather effective ceiling has already been placed upon the future delivered cost of natural rubber, primarily by the development of buna type synthetic rubber. The butyl type is recognized as superior to natural rubber for some special purposes, notably in inner tubes, and will therefore be an important member of the future rubber family.

With the use of 950 pounds of carbon black per long ton of synthetic rubber and 460 pounds per ton of natural, the demand for black in rubber (including 100 million pounds yearly estimated for use in reclaimed) would be about 1,182 million pounds in the first postwar year and average 1,084 million pounds in the 5-year period. To the extent that foreign production of carbon black increases, the demand

¹ U. S. Tariff Commission, Report 6, War Changes in Industry Series, p. 81.

from United States sources will be lessened. On the other hand, a larger consumption of rubber than is projected above would require more carbon black. It must be emphasized that the potential influence of technical advances and Government policy upon future events in this industry is very great and inscrutable. The above figures result from an attempt to reconcile probabilities that appear to be logical outgrowths of the current situation.

It is estimated that consumption of carbon black for purposes other than rubber compounding will average 56 million pounds per year, trending upward from about 52 million in the first postwar year.

An average annual consumption of carbon black for all purposes of 1,140 million pounds is thus indicated for the 5 years succeeding the war, about 1,234 million pounds being needed in the first year and smaller amounts thereafter as more natural rubber enters the trade.

It is anticipated that the total productive capacity of the carbon-black industry in the United States at the end of 1945 will approximate 1,450 million pounds per year, of which about 200 million pounds will represent Government-owned channel-plant facilities. An additional indeterminate portion of total capacity will fall into the emergency high-cost category, supplying the swollen demands of war but destined to cease production upon the return of normal competitive conditions. The ultimate disposition of the Government plants will of course affect the trade position of commercial plants. Of greater moment, however, to the delineation of the postwar economic climate within the industry will be the extent of direct competition between blacks of the channel and furnace types.

Information currently available indicates that the return to large use of natural rubber will increase the demand for channel black, although its fields of application may be narrowed (as compared with the prewar period) by the availability of suitable furnace blacks at competitive costs. Higher future costs for gas at channel plants, which appear to be in prospect, would operate to the competitive disadvantage of these plants because of the low-product yields. The principal furnace grades may therefore have the advantage of lower unit production costs which would encourage their substitution for channel blacks, on a price basis, for many purposes for which the two types of black are more or less interchangeable on a quality basis.

PRODUCTION

By States.—Texas production increased 23 percent in 1944 to a new record of 501,162,000 pounds, owing to gains of 16 percent in the Panhandle, where more gas became available to carbon-black plants, and 61 percent in other parts of the State. Texas' share of the total United States output, however, declined to 62 percent, prolonging a trend that has persisted since 1938, when the State produced 87 percent of the total.

An expansion of 46 percent over 1943 in Louisiana raised production to 160,019,000 pounds, exceeding the old 1924 record by 11 percent. Oklahoma production of 53,887,000 pounds was 72 percent above 1943, and output of the California-Kansas-New Mexico group gained 93 percent in 1944 despite a decline in California.

Methods and yields.—The average yield of all carbon blacks increased to 2.20 pounds per thousand cubic feet of gas burned in 1944 from

Carbon black produced from natural gas in the United States in 1944, by States and by major producing districts

State and district	Producers reporting ¹	Number of plants	Production			Natural gas used			
			Pounds	Value at plant		M cubic feet	Average yield per M cubic feet (pounds)	Value	
				Total	Average (cents)			Total	Average per M cubic feet (cents)
California.....	1	1	86,792,000	\$3,474,000	4.00	16,516,000	5.26	\$670,000	4.06
Kansas.....	2	3							
New Mexico.....	1	1							
Louisiana.....	7	7	160,019,000	5,421,000	3.39	23,466,000	6.82	607,000	2.59
Oklahoma.....	3	3							
			53,887,000	1,787,000	3.32	6,416,000	8.40	227,000	3.54
Texas:									
Panhandle district.....	17	31	401,556,000	14,234,000	3.54	267,323,000	1.43	3,735,000	1.40
Rest of State.....	4	8	99,606,000	4,495,000	4.51	42,046,000	2.37	524,000	1.25
Total Texas.....	17	39	501,162,000	18,729,000	3.74	309,369,000	1.56	4,259,000	1.38
Total United States.....	22	54	801,860,000	29,411,000	3.67	355,770,000	2.20	5,763,000	1.62

¹ In counting the total number of producers reporting, a producer operating in more than 1 State, district, or county is counted but once.

² Includes carbon black made from liquid hydrocarbons.

1.88 pounds in 1943, influenced by further rapid gains in furnace-plant operations. Higher yields were indicated in all districts.

Furnace blacks constituted 48 percent of total production in 1944 and 36 percent in 1943. Early in 1945, about 50 percent of the output of furnace black was of the semireinforcing grade, over 30 percent high modulus, and the balance thermal.

Furnace plants in 1944 consumed 40,444 million cubic feet of natural gas and over 10 million gallons of liquid hydrocarbons. The yields by furnace processes, expressed in pounds per thousand cubic feet of gas, vary from 3 to 16 pounds, depending upon the quality of black produced and the proportion of gas to liquids processed. No specific data are available to measure the quantity of black recovered from oil, and therefore an expression of average yield on the basis of gas input alone cannot accurately reflect the efficiency of the process. It has been stated, however, that by furnace methods 25 percent or more of the carbon in natural gas may be recovered in the form of carbon black.² This indicates at least five times the efficiency of the channel method.

The remainder of the total output, obtained by contact processes, declined to 52 percent in 1944 from 64 percent in 1943. Of the total contact-type production in 1944, almost 80 percent was of easy-processing grade, about 10 percent medium-processing, 3 percent hard-processing, and the remainder "other than rubber" grades. The yield of contact blacks averaged 1.32 pounds per thousand cubic feet of natural gas in 1944 and 1.30 pounds in 1943.

Number and capacity of plants.—Two new plants began production in 1944 as follows:

Continental Carbon Co.—furnace type—at Sunray, Tex.

Phillips Petroleum Co.—furnace type—at Borger, Tex.

The channel plant at Sayre, Okla., did not produce in 1944. It was dismantled and sold. In Louisiana the "Special" contact-type

² Miller, Benjamin, *Postwar Chemical Uses of Natural Gas*: Oil Weekly, Apr. 30, 1945, p. 50.

plant near Bourland was dismantled and the channel plant at Bastrop discontinued operation on November 30, 1944. The roller-type plant at Ryus, Kans., was shut down during 1944.

As a result of these changes, the number of operating plants on December 31, 1944, was reduced to 52 from 54 a year earlier.

In 1944 and the first quarter of 1945, new facilities for production were completed and placed in operation at five new plants and nine producing plants whose capacities were increased. These projects added 146,174,000 pounds to the industry's annual productive ability.

The daily capacity of all plants was increased from 2,166,713 pounds at the end of 1943 to 2,585,416 pounds on December 31, 1944 (19 percent). The ratio of production to total capacity at the year end was 85 percent for 1944 and 75 percent for 1943.

The capacity of contact-type plants totaled 1,344,064 pounds daily on December 31, 1943, and 1,347,710 pounds on December 31, 1944, an insignificant change. Furnace-plant capacity expanded in the same period from 822,649 to 1,237,706 pounds or 50 percent.

Producers.—The Phillips Petroleum Co. was added to the 1944 list of producers. Two or three additional companies using high-yield processes are expected to enter the field in 1945.

DEMAND

Total deliveries.—Producers delivered 937,430,000 pounds of carbon black of all grades in 1944, or 49 percent more than in 1943 and more than double the 1942 total. Miscellaneous users took less black in 1944, but sales to all other domestic trades and for export increased (see fig. 2). Rubber-grade channel blacks were placed under allocation control in July 1944 by the War Production Board, and thereafter rubber-grade blacks were purchased by the Defense Supplies Corporation and resold to rubber companies.

Domestic demand.—Deliveries of 780,478,000 pounds to domestic consumers were 49 percent above the former record of 1943. Demand from rubber companies was more dominant than ever before, absorbing 738,029,000 pounds or 95 percent of total domestic sales compared with 90 percent in 1943.

Sales for rubber manufacture averaged about 70 million pounds per month in the first three quarters of 1944 but jumped to over 90 million in November and remained above 80 million for several succeeding months. Probably this high rate of sales exceeded for a brief period the actual rate of consumption.

Use of synthetic rubber on a large scale has not only accentuated the total demand for carbon black but has caused radical shifts in the relative importance of the various rubber grades. The rapid advance of furnace-type blacks is well-known. The particle sizes in these blacks range larger than in the channel types. Trade reports indicate that current trends are toward the use of more furnace grades of relatively fine texture, particularly the semireinforcing blacks. Among the channel blacks, increasing emphasis has been placed upon easy-processing grades at the expense of the hard grades whose particle size is extremely small. These two preferred types appear to cover the widest area of application of carbon blacks in synthetic rubber, that forms a common meeting ground for furnace and channel blacks, in which they supplement each other and in some degree are interchangeable in practice.

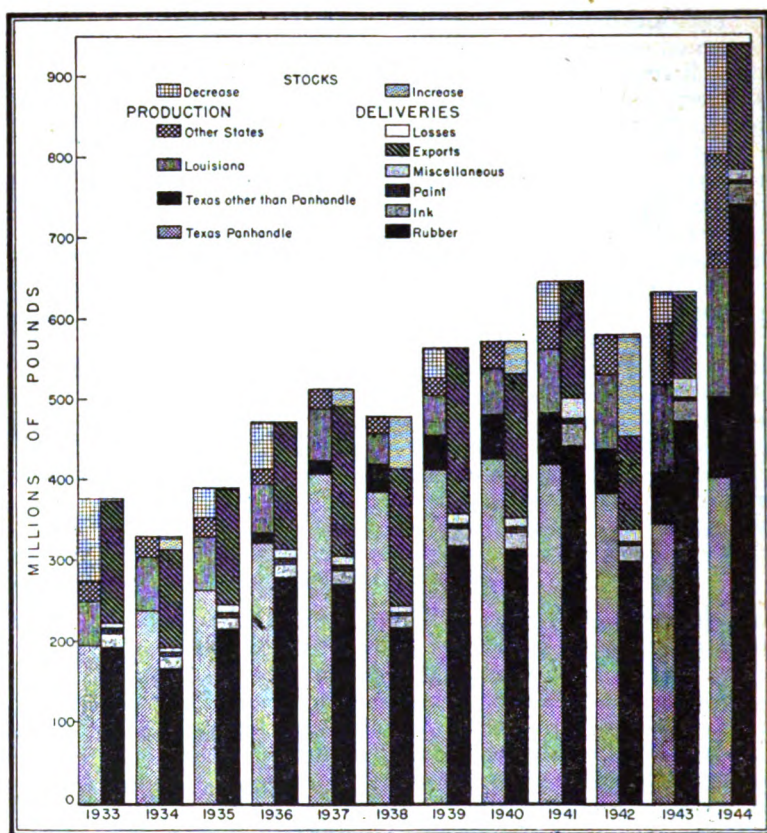


FIGURE 2.—Production and consumption of carbon black, 1933-44. Production in "Texas other than Panhandle" included in "Other States," 1933-35.

Ink companies purchased 24,479,000 pounds of carbon black in 1944, an increase of 4 percent over 1943. According to the Bureau of Foreign and Domestic Commerce, the apparent total consumption of newsprint in the United States was 3,243,000 short tons in 1944 compared with the revised total of 3,627,000 tons in 1943. Disregarding changes in stocks in the hands of consumers, the use of carbon black by ink companies has increased from 5.58 pounds per ton of newsprint consumed in 1939 to 7.55 pounds in 1944.

Demand from paint companies increased 35 percent over 1943 to 5,315,000 pounds. The tremendous volume of naval and merchant ship construction in 1944 required great quantities of gray and other dark paints, which probably exerted an important influence on the carbon-black needs of paint manufacturers.

Sales to miscellaneous industries declined sharply (46 percent) in 1944 to 12,655,000 pounds. This contraction of business is thought to have been chiefly the result of allocation restrictions upon non-essential uses of black, with concurrent reduction of consumers' inventories. Some easing of these conditions is probable in 1945.

*Exports and imports.*³—A 3-year decline in exports was reversed in 1944, as shipments of 156,951,963 pounds were 50 percent above 1943. The largest gains were to the United Kingdom, Canada, and the Union of South Africa, which with India were the four largest importers of carbon black. Together they took 84 percent of total United States exports. Deliveries to the U. S. S. R., Sweden, Australia, and New Zealand were sharply higher, and smaller amounts were taken in 1944 by Spain, Brazil, and several other Latin-American countries whose receipts had increased during the war.

Carbon black exported from the United States, 1943-44, by months and customs districts

Month	1943		1944		Customs district	1943		1944	
	Pounds	Value	Pounds	Value		Pounds	Value	Pounds	Value
Jan.....	10,594,141	\$469,836	6,560,872	\$283,084	Buffalo.....	273,728	\$17,532	979,289	\$43,260
Feb.....	6,134,731	221,028	11,566,588	527,433	El Paso.....	1,665,650	89,171	1,183,575	47,794
Mar.....	5,991,676	268,772	19,577,266	923,801	Galveston.....	27,320,064	1,342,910	59,247,664	2,934,185
Apr.....	7,188,444	333,603	14,407,766	666,071	Georgia.....	16,451,105	795,373	18,873,307	910,373
May.....	11,184,291	513,566	13,058,505	631,322	Laredo.....	1,586,000	73,975	2,131,857	92,278
June.....	7,498,911	341,777	13,789,352	674,766	Los Angeles.....	2,190,403	92,858	836,100	52,445
July.....	5,767,363	263,376	13,774,533	652,232	Michigan.....	27,212,702	1,016,307	37,687,852	1,447,949
Aug.....	6,587,117	308,136	10,925,485	548,655	New Orleans.....	10,645,350	557,055	16,891,130	871,902
Sept.....	10,723,053	519,418	8,074,561	391,382	New York.....	8,126,095	400,214	8,477,459	482,490
Oct.....	10,158,283	479,911	16,947,619	816,108	Philadelphia.....	2,093,116	104,282	1,796,520	105,051
Nov.....	12,638,095	585,702	13,111,199	623,796	San Francisco.....	2,289,400	106,891	3,408,058	200,922
Dec.....	11,476,667	519,148	15,168,187	742,735	Other districts..	5,058,159	247,695	5,441,652	292,726
	104,911,772	4,824,263	156,951,963	7,481,375		104,911,772	4,824,263	156,951,963	7,481,375

Carbon black exported from the United States, 1942-44, by countries

Country	1942		1943		1944	
	Pounds	Value	Pounds	Value	Pounds	Value
Argentina.....	3,215,276	\$161,503	617,341	\$37,656	568,735	\$36,523
Australia.....	7,833,813	405,850	3,738,075	172,963	6,393,433	360,755
Brazil.....	2,626,163	131,840	6,599,200	321,455	4,067,702	214,220
Canada.....	29,650,763	1,070,714	27,667,557	1,044,229	39,059,668	1,510,720
Chile.....	75,199	5,063	141,425	7,776	239,738	13,613
Colombia.....	175,187	8,836	736,598	33,939	151,916	9,510
Cuba.....	364,475	19,173	366,890	21,612	1,088,675	58,626
Egypt.....	186,390	5,331	193,250	10,864	30,450	2,507
Guatemala.....	2,493	135	35,004	1,728	17,225	1,135
India and Dependencies.....	7,648,607	354,672	9,071,851	427,322	12,114,361	630,535
Mexico.....	4,841,480	133,163	3,261,683	143,162	3,329,528	141,342
Netherlands Indies.....	756,075	44,458				
New Zealand.....	363,187	18,555	227,050	11,293	894,067	49,176
Peru.....	900	50	320,426	16,061	242,434	12,410
Portugal.....	84,997	5,547	68,741	4,266	51,257	3,058
Spain.....	565,150	28,047	1,373,050	77,414	947,760	50,949
Sweden.....	265,275	17,486	69,900	5,088	1,416,851	87,505
Union of South Africa.....	2,618,460	126,396	4,547,319	220,292	9,413,576	464,453
U. S. S. R.....			57,100	8,256	4,204,458	256,170
United Kingdom ¹	53,296,513	2,608,449	45,109,474	2,213,845	71,333,550	3,492,113
Other countries.....	1,064,754	83,876	719,838	45,022	1,386,589	86,035
	115,635,157	5,229,144	104,911,772	4,824,263	156,951,963	7,481,375

¹ United Kingdom of Great Britain and Northern Ireland.

Shipments were heavy in March and April and in the last quarter when they averaged over 15 million pounds monthly.

Carbon black exported in 1944 was valued at an average of 4.77 cents a pound compared with 4.60 cents in 1943 and the low point of recent years of 4.36 cents in 1939.

³ Figures on exports and imports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Exports from the Galveston customs district more than doubled in 1944, and material gains were reported by the Michigan, New Orleans, and Georgia districts. The comparatively small business through the Los Angeles, El Paso, and Philadelphia districts declined.

Imports of "gas black and carbon black" from Canada continued the upward trend of recent years, amounting to 267,158 pounds valued at \$26,288 in 1944, or 28 and 26 percent, respectively, above 1943. Imports of acetylene black, also received from Canada, increased 82 percent over 1943 to 8,574,693 pounds valued at \$841,483 (9.81 cents a pound) compared with \$381,204 (9.75 cents a pound) in 1943. This material is widely used in the manufacture of dry-cell batteries because of its electrical conductivity.

STOCKS

For the first time in the chapter of this series the stocks of carbon black are segregated into the contact and furnace types. The contact blacks in producers' hands were reduced by urgent demand from 196,913,000 pounds on December 31, 1943, to 58,036,000 pounds at the end of 1944 and fell still further early in 1945.

The very small stock of furnace black on December 31, 1943 (8,302,000 pounds), was built up to 11,207,000 pounds on December 31, 1944, indicating that furnace-black production kept pace with the rapidly growing demand. These stocks, however, had totaled about 18 million pounds in October 1944 and were drawn down, in succeeding months, to a level approximating that of a year earlier.

PRICES AND VALUES

Although price ceilings set by the Office of Price Administration were unchanged in 1944, the average value of carbon black at the plants increased to 3.67 cents a pound from 3.41 cents in 1943. The explanation of the increase is to be found in the rapid gain in output of some furnace grades which sell at higher than average prices.

Continuing pressure for a greater output of channel black caused the Office of Price Administration in March 1945 to raise the price ceiling on added production of rubber grades of channel black obtained under emergency high-cost conditions.

ASPHALT AND RELATED BITUMENS

By A. H. REDFIELD ¹

SUMMARY OUTLINE

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SUMMARY

In spite of low activity in new highway construction, maintenance and repair work on the existing highways and Government purchases for camps and airfields raised the indicated demand for petroleum asphalt from 6,631,839 short tons in 1943 to 6,944,371 tons in 1944. To meet an increase of 312,532 tons in domestic demand and of 24,413 tons in export demand, petroleum refineries increased their output 239,400 tons over 1943, and imports of petroleum and lake asphalt increased 8,145 tons. To meet the difference of 89,400 tons between increased demand and increased new supply, stocks of asphalt held at refineries increased only 62,900 tons during 1944, compared with an increase of 152,300 tons during 1943.

Domestic demand for native asphalts and bitumens was 12 percent lower than in 1943. Sales of gilsonite were 3 percent less than in 1943, and sales of bituminous rock declined 11 percent.

NATIVE ASPHALT AND BITUMENS

Bituminous rock.—Decreased road-building activity in 1944, partly offset by increased maintenance and repair, resulted in a decline in sales of bituminous rock from 835,648 short tons valued at \$3,096,753 in 1943 to 740,454 tons valued at \$2,771,925 in 1944. The decline was greatest west of the Mississippi River. Sales by producers in Texas and Oklahoma decreased from 600,545 tons valued at \$1,673,689 in 1943 to 479,745 tons valued at \$1,214,329 in 1944. Smaller sales of rock asphalt were made in California and Utah, but larger sales in Missouri. In Kentucky and Alabama, however, producers increased their sales of rock asphalt from 185,723 tons valued at \$1,093,981 in 1943 to 226,190 tons valued at \$1,315,234 in 1944.

Gilsonite and wurtzilite.—A slight decline in tonnage of gilsonite sold by producers in Utah occurred—from 50,446 short tons valued at \$1,188,485 in 1943 to 49,051 tons valued at \$918,480 in 1944. The

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

average sales price per ton at the mine or railhead decreased from \$23.56 in 1943 to \$18.73 in 1944.

Sales of wurtzilite produced in Utah decreased from 41 short tons valued at \$3,250 in 1943 to 11 tons valued at \$874.

Exports.—The tonnage of natural asphalt, unmanufactured, exported from the United States increased from 34,796 short tons in 1943 to 37,210 tons in 1944. The value of these exports, however, decreased from \$819,355 to \$729,765. Although a smaller tonnage of natural asphalt was exported to North American countries and to western Europe than in 1943, larger shipments were made in 1944 to Australia, New Zealand, British India, Saudi Arabia, Madagascar, and the Union of South Africa.

MANUFACTURED OR PETROLEUM ASPHALT

Production.—Production of asphalt by petroleum refineries in the United States increased 3½ percent from 1943. The principal gains in tonnage made were in the East Coast district, in the Rocky Mountain district, in California, and in Louisiana and Arkansas Inland. Proportionally, however, the Rocky Mountain district had the highest increase, followed by the East Coast district, and by Arkansas and Louisiana Inland. In contrast to the national increase, less asphalt was manufactured in central United States, notably the Louisiana Gulf Coast, Texas Inland, Oklahoma-Kansas-Missouri, and Texas Gulf Coast. The greatest decreases, both in tonnage and in proportion, were in the Louisiana Gulf Coast and Texas Inland.

Stocks.—Stocks of petroleum asphalt held at refineries were 11 percent higher on December 31, 1944, than on December 31, 1943. The most marked increases in inventories were in the Oklahoma-Kansas-Missouri district, the East Coast district, the Arkansas-Louisiana

Production, receipts, stocks, consumption, transfers, losses, exports, and domestic sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1944, by districts, in short tons

District	Production	Receipts from other sources	Stocks		Consumption by companies, transfers, losses, and exports	Sales to domestic consumers
			Dec. 31, 1943	Dec. 31, 1944		
East Coast.....	1,387,700	127,100	81,100	100,200	99,300	1,396,400
Appalachian.....	333,800	27,900	19,500	33,400	12,800	335,000
Indiana, Illinois, Kentucky, etc.....	1,419,300	5,400	113,800	115,100	124,700	1,298,700
Oklahoma, Kansas, and Missouri.....	624,000	24,700	69,300	96,900	12,900	608,200
Texas:						
Gulf Coast.....	372,000	-----	29,100	20,900	90,500	289,700
Inland.....	306,500	1,900	32,400	21,100	32,300	287,400
Total Texas.....	678,500	1,900	61,500	42,000	122,800	577,100
Louisiana-Arkansas:						
Louisiana Gulf Coast.....	306,900	-----	54,500	51,100	26,400	283,900
Arkansas and Louisiana Inland.....	402,900	10,700	28,500	42,900	53,500	345,700
Total Louisiana-Arkansas.....	709,800	10,700	83,000	94,000	79,900	629,600
Rocky Mountain.....	318,400	94,300	33,000	40,600	28,800	376,900
California.....	1,524,600	10,500	101,500	104,000	19,300	1,513,300
Total United States:						
1944.....	6,996,100	302,500	563,300	626,200	500,500	6,735,200
1943.....	6,756,700	717,400	411,000	563,300	424,000	6,897,800

Inland district, and the Appalachian district. In contrast, inventories in Texas Inland, the Texas Gulf Coast, and the Louisiana Gulf Coast were lower at the end of 1944 than at the end of 1943.

Sales.—Sales of petroleum asphalt by refineries to domestic consumers in the United States decreased 2 percent in quantity but 4 percent in value from 1943 to 1944. The average value at the refinery decreased from \$11.43 per short ton in 1943 to \$11.24 in 1944.

Of the total sold, 10.6 percent was manufactured from foreign petroleum (imported chiefly from Venezuela, Colombia, and Mexico) in 1944 compared with 4 percent in 1943. Although runs of foreign crude to stills increased 254 percent from 1943 to 1944, sales of petroleum asphalt from this source increased only 137 percent. Of the foreign crude processed, 14 percent (revised figure) was converted into asphalt in 1943 but only 9 percent in 1944. East Coast refineries sold 99 percent of the total asphalt made from foreign crude in 1944 compared with 71 percent in 1943. Gulf Coast refineries of Louisiana supplied the small remainder.

Highway and street construction and airport-runway surfacing (in the form of paving asphalt, paving flux, cut-back asphalts, and asphalt emulsions) used 71 percent (revised figure) of the total asphalt sold to domestic consumers by petroleum refineries in 1943 and 67 percent in 1944. Street and road contracts exceeding \$25,000, according to

Asphalt and asphaltic material (exclusive of road oil) sold at petroleum refineries to domestic consumers in the United States in 1944, by varieties

[Value f. o. b. refinery]

Variety	From domestic petroleum		From foreign petroleum		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Solid and semisolid products of less than 200 penetration:						
Asphalt for—						
Paving.....	1,683,257	\$18,134,419	206,709	\$2,840,874	1,889,966	\$20,975,293
Roofing.....	932,919	11,917,348	272,413	3,518,058	1,205,332	15,435,406
Waterproofing.....	67,733	909,602	28,534	373,297	94,267	1,282,899
Blending with rubber.....	16,090	206,647	4,099	56,520	20,189	263,167
Briquetting.....	108,180	965,266			108,180	965,266
Mastic and mastic cake.....	5,272	86,238			5,272	86,238
Pipe coatings.....	16,945	216,944	38	512	16,983	217,466
Molding compounds.....	41,078	534,995			41,078	534,995
Miscellaneous uses.....	228,301	3,114,191	35,493	509,335	263,794	3,623,526
	3,099,775	36,085,650	545,286	7,298,596	3,645,061	43,384,246
Semisolid and liquid products of more than 200 penetrations:						
Flux for—						
Paving.....	193,502	1,480,699	29,739	349,885	223,241	1,830,584
Roofing.....	551,393	4,875,326	6,827	98,953	558,220	4,974,279
Waterproofing.....	6,262	58,036			6,262	58,036
Mastic.....	2,642	34,770			2,642	34,770
Cut-back asphalts:						
Rapid-curing.....	603,769	7,109,364	85,592	1,211,030	689,361	8,320,394
Medium-curing.....	1,327,922	13,851,661	38,235	546,045	1,366,157	14,397,706
Emulsified asphalts and fluxes.....	96,882	1,105,874	507	7,907	97,389	1,113,781
Paints, enamels, japans, and lacquers.....	30,712	523,461	4,054	57,214	34,766	580,675
Other liquid products.....	110,095	984,441	1,982	35,752	112,077	1,020,198
	2,923,179	30,023,632	166,936	2,306,786	3,090,115	32,330,418
Total:						
1944.....	6,022,954	66,109,282	712,222	9,605,382	6,735,176	75,714,664
1943.....	6,597,382	74,686,638	300,421	4,176,192	6,897,803	78,862,830

Sales of asphalt (exclusive of road oil) at petroleum refineries to domestic consumers in the United States, 1943-44, by districts

District	1943		1944	
	Short tons	Value	Short tons	Value
East Coast.....	1,048,944	\$14,675,424	1,396,399	\$19,134,342
Appalachian.....	286,040	3,941,164	335,013	4,862,072
Indiana, Illinois, Kentucky, etc.....	1,468,704	18,122,413	1,298,727	16,064,817
Oklahoma, Kansas, and Missouri.....	662,696	6,377,803	608,190	5,269,350
Texas:				
Gulf Coast.....	361,832	3,915,416	289,694	2,884,935
Inland.....	379,823	3,669,341	287,396	3,172,139
Total Texas.....	741,655	7,584,757	577,090	6,057,074
Louisiana-Arkansas:				
Louisiana Gulf Coast.....	452,917	5,555,905	283,923	3,147,050
Arkansas and Louisiana Inland.....	347,369	3,140,374	345,706	2,923,456
Total Louisiana-Arkansas.....	800,286	8,696,279	629,629	6,070,506
Rocky Mountain.....	272,323	3,196,267	376,856	3,027,864
California.....	1,617,155	16,268,733	1,513,273	15,228,639
Total United States.....	6,897,803	78,862,830	6,735,176	75,714,664

Engineering News-Record, showed a decrease of 14 percent in value—from 227.2 million dollars in 1943 to 195.7 million dollars in 1944—and of 16 percent in indicated volume if the values are adjusted by the Engineering News-Record index of construction costs. The decreases were greatest in the 10 Southeastern States and Louisiana, in the Middle Atlantic States, and in New England. They were least in the 5 States lying between the Ohio River and the Great Lakes and in the 14 States lying west of the Mississippi River and Rocky Mountains.

Although less new road construction was done in 1944, maintenance operations were at a high level. In consequence, sales of paving asphalt used for high-type surfacing declined only 5 percent—from 1,982,457 tons in 1943 to 1,889,966 in 1944. Sales of cut-back asphalts suitable for surfacing lighter-type highways were 7 percent lower in 1944 than in 1943. The popularity of medium-curing cut-backs continued to increase; 3 percent more of this type of cut-back was sold in 1944 than in 1943, but sales of rapid-curing cut-backs decreased 21 percent.

Less emulsified asphalt was sold in 1944 than in 1943. Petroleum refineries sold 107,954 short tons (25,436,068 gallons) valued at \$1,220,177 in 1943 and 97,389 tons (22,946,747 gallons) valued at \$1,113,781 in 1944; in addition, 74,743,426 gallons valued at \$7,003,989 in 1943 (revised figures) and 65,726,027 gallons valued at \$5,970,053 in 1944 were sold by major industrial companies that purchased asphalt from petroleum refineries and manufactured it into emulsions. Accordingly, total known sales of emulsified asphalts and fluxes decreased 11.5 percent in quantity—from 100,179,494 gallons in 1943 to 88,672,774 gallons in 1944—and 14 percent in value—from \$8,224,166 to \$7,083,834.

Roofing manufacture made the second-largest demand for asphalt, absorbing 24 percent of the total sales to domestic consumers in 1943 and 26 percent in 1944. Although shipments of prepared roofing reported to the Bureau of the Census decreased 0.4 percent—from 48,892,000 squares in 1943 to 48,691,000 squares in 1944—domestic

sales of roofing asphalt and roofing flux combined increased 5.6 percent—from 1,670,465 short tons in 1943 to 1,763,552 tons in 1944. These figures do not include roofing asphalt and flux consumed by the companies in factories of prepared roofing owned by themselves or by affiliated companies.

DOMESTIC DEMAND

The indicated average monthly domestic demand for petroleum asphalt (including small quantities of imported lake asphalt and grahamite) was 5 percent larger in 1944 than in 1943, increasing from 552,653 to 578,698 tons.

In order to cover the most recent developments, the long-time trend of monthly asphalt demand has been revised to include 1908 to 1944. The effect of including the last 4 years (which were characterized by extremely high demand) has been to raise the general level of the trend for recent years and to lower the relation between the actual demand for those years and the expected demand according to the trend. This is illustrated by the following table, which shows the relation between the actual average monthly demand from 1925 to 1944 and the expected monthly demand for that period. This comparison indicates that the 5 years 1940-44 have been characterized by rising demand for asphalt, except for 1942, and that the upward trend had shown no sign of downturn to the end of 1944.

In terms of the revised long-term trend, the indicated demand was 38 percent above the expected demand for 1943 and 40 percent above that for 1944; that is, if the national demand had continued the average rate of growth it manifested from 1908 to 1944, it would have averaged 400,949 tons a month in 1943 and 412,072 tons a month in 1944. If these averages are used as a standard of comparison the indicated demand of 552,653 tons in 1943 was 138 percent of the expected demand (400,949 tons), and the indicated demand of 578,698 tons a month in 1944 was 140 percent of the expected demand (412,072 tons).

Relation of indicated average monthly asphalt demand in the United States to basic trend, 1925-44, by years

Year	Long-time trend, 1908-44 (short tons)	Indicated average monthly demand (short tons)	Relation of indicated average monthly demand to trend (percent)
1925	200,656	242,502	120.9
1926	211,788	266,937	126.0
1927	222,920	296,340	132.9
1928	234,052	260,577	111.3
1929	245,188	287,550	117.3
1930	256,312	238,271	93.0
1931	267,441	228,711	85.5
1932	278,576	191,277	68.7
1933	289,698	191,337	66.0
1934	300,824	214,166	71.1
1935	311,952	252,304	80.9
1936	323,078	300,188	92.9
1937	334,224	337,442	101.0
1938	345,329	367,071	106.3
1939	356,445	397,396	111.5
1940	367,578	430,112	117.0
1941	378,702	546,467	144.3
1942	389,825	524,708	134.6
1943	400,949	552,653	137.8
1944	412,072	578,698	140.4

FOREIGN TRADE

Imports.—Imports of natural asphalt and bitumen into the United States in 1944 totaled 8,235 short tons valued at \$254,135 compared with 8,142 tons valued at \$221,503 in 1943. Imports of lake asphalt from Trinidad increased from 6,966 short tons valued at \$202,082 in 1943 to 8,062 tons valued at \$249,866 in 1944, but imports of grahamite from Cuba decreased from 999 tons valued at \$17,900 to 102 tons valued at \$2,242.

Imports of solid asphalt increased from 101,089 short tons valued at \$567,832 in 1943 to 116,119 tons valued at \$652,221 in 1944. Of the 1943 and 1944 imports, virtually all came from the Netherlands West Indies.

Petroleum asphalt exported from the United States, 1942-44, by countries

Country	1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value
North America:						
Canada.....	9,918	\$246,346	3,607	\$196,573	4,225	\$238,827
Cuba.....	138	4,659	80	1,832	228	7,526
Guatemala.....	1,462	73,446	728	17,204	213	3,499
Mexico.....	2,803	49,477	3,891	74,695	2,989	47,068
Newfoundland and Labrador.....	5,564	108,314	4,109	86,070	2,008	39,081
Nicaragua.....	1,186	20,792	1,158	23,258	616	13,090
Panama:						
Canal Zone.....	24,166	384,192	8,956	201,406	1,695	46,988
Republic of.....	2,657	54,091	51	1,626	316	5,225
Other North America.....	4,981	71,462	5,283	107,772	1,467	26,677
	52,875	1,012,779	27,863	710,439	13,757	417,961
South America:						
Argentina.....	6	341	3	120	13	807
Brazil.....	3,455	64,588	1,116	33,965	10,514	208,907
Chile.....	2,362	43,906	3,577	69,831	2,146	45,555
Uruguay.....	279	5,117	762	14,023	1,402	24,676
Venezuela.....	477	9,900	133	5,786	139	3,785
Other South America.....	2,334	31,506	434	8,978	2,302	49,639
	8,913	155,450	6,025	132,703	16,516	333,259
Europe:						
Portugal.....	19	998			1,524	28,228
Spain.....			8	326		
Sweden.....	10	598			527	15,531
United Kingdom.....	442	20,559				
Other Europe.....	7	575				
	478	22,730	8	326	2,051	43,759
Asia:						
India and Dependencies.....	4,111	99,429	5,120	121,920	17,348	405,267
Other Asia.....	5	205	68	3,284	55	2,193
	4,116	99,634	5,188	125,204	17,403	407,460
Africa:						
Belgian Congo.....	53	2,212	74	1,980	57	1,390
British East Africa.....	33	1,037	59	4,092	25	1,819
Mozambique.....	46	4,040			2	184
Nigeria.....	547	18,011	2,741	91,165		
Union of South Africa.....	517	9,756	683	29,066	3,286	60,942
Other Africa.....	482	16,378	1,605	53,208	1,605	53,288
	1,678	51,434	5,162	179,501	4,975	117,623
Oceania:						
Australia.....	12,528	171,526	34,582	850,118	54,066	1,074,447
New Zealand.....	4,048	68,530	12,311	282,329	6,786	157,214
Other Oceania.....	168	3,410				
	16,744	243,466	46,893	1,132,447	60,852	1,231,661
	84,804	1,585,493	91,139	2,280,620	116,554	2,551,723

In addition, 51,409 barrels (9,347 tons) valued at \$91,001 of liquid petroleum asphalt, including cut-backs and road oil, were imported in 1943 and 13,033 barrels (2,370 tons) valued at \$20,801 in 1944. Mexico supplied all the liquid petroleum asphalt imported in 1943, and the Netherlands West Indies all imported in 1944.

Exports.—Exports of petroleum asphalt increased 27 percent from 1943 to 1944 but still were little more than half of the corresponding exports of 1941. The principal gains were in exports to the south-western Pacific, where large shipments to Australia were only partly offset by decreased exports to New Zealand. In Asia, shipments of petroleum asphalt to British India more than trebled from 1943 to 1944. Brazil accounted chiefly for the greater shipments of asphalt to South America in 1944 than in 1943. Portugal received three-fourths of the small exports to Europe in 1944. In North America small increases in exports of asphalt to Canada, Cuba, and the Republic of Panama were insufficient to offset the general decline in asphalt shipments to neighboring countries.

ROAD OIL

The manufacture and sale of road oil were reported in 1944 chiefly by Texas, California, and the Rocky Mountain district. What was sold in 1943 and 1944 as road oil might better have been described as liquid asphalt, as the use of road oil for highway purposes was officially prohibited for most of the year.

Production, receipts, stocks, consumption, transfers, losses, exports, and domestic sales of road oil in the United States in 1944, by districts, in thousand of barrels

District	Production	Receipts from other sources	Stocks		Consumption by companies, transfers, losses, and exports	Sales to domestic consumers
			Dec. 31, 1943	Dec. 31, 1944		
East Coast.....	95	78	10	19	86	78
Indiana, Illinois, Kentucky, etc.....	32	1	-----	2	28	3
Oklahoma, Kansas, and Missouri.....	45	4	5	5	9	40
Texas.....	2	947	5	4	2	948
Louisiana-Arkansas.....	20	4	3	2	21	4
Rocky Mountain.....	569	70	79	74	487	157
California.....	793	-----	91	83	-----	801
Total: 1944.....	1,556	1,104	193	189	633	2,031
1943.....	2,295	187	348	193	583	2,054

Road oil sold by petroleum refineries to domestic consumers in the United States, 1943-44, by districts

District	1943		1944	
	Thousands of barrels	Thousands of dollars	Thousands of barrels	Thousands of dollars
East Coast.....	1	2	78	214
Indiana, Illinois, Kentucky, etc.....	35	53	3	8
Oklahoma, Kansas, and Missouri.....	52	89	40	78
Texas.....	2	7	948	1,553
Louisiana-Arkansas.....	-----	-----	4	7
Rocky Mountain.....	686	1,137	157	245
California.....	1,278	2,558	801	1,680
Total United States.....	2,054	3,846	2,031	3,783

For 10 months of 1944, Petroleum Directive 72 of the Petroleum Administration for War, dated September 9, 1943, continued its restrictions on the delivery or acceptance of road oil for use as a paving material or as a dust palliative. By an amendment of November 1, 1944, Petroleum Directive 72 was revoked except for Washington, Oregon, California, Nevada, and Arizona. Accordingly, the statistics of road oil for 1944 refer to liquid asphalts having a penetration less than 350 after distillation to 680° F.

POSTWAR PROSPECTS

Although funds, materials, and labor were expended in 1944 to repair and maintain the Nation's highways and compensate for wartime wear and tear, it is evident that at the end of the war extensive reconstruction of the network of roads will be needed. The Federal Highway Act of 1944, passed late in the year, provides one-half billion dollars a year for each of 3 years following the war, to be matched equally by the States, counties, or cities receiving the funds. The act requires that the States, acting jointly, shall designate a national system of interstate highways, not exceeding a total of 40,000 miles, to be integrated with the Federal-aid system. Where necessary, the National Interregional Highway Committee recommended that existing highways be rebuilt to modern superhighway standards or be replaced by new highways where modernization would be impracticable or undesirable.¹ All this should create a good market for paving asphalt, paving flux, cut-back asphalts, and asphalt emulsions.

The Engineering News-Record estimated that 900,000 to 1,600,000 dwelling units will be needed annually for the first 10 postwar years, as a result of the general lack of residential construction during the war years. Many manufacturers undoubtedly will build new industrial plants rather than endeavor to adapt idle munition plants to their specialized needs. All this should serve to prolong the wartime demand for roofing asphalt and flux, waterproofing asphalt, mastic, pipe coatings, and paints and enamels.

¹Engineering News-Record, vol. 134, No. 6, Feb. 8, 1945, pp. 109-110.

CEMENT

By G. RICHARDS GWINN AND ESTHER V. BALSER

SUMMARY OUTLINE

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SUMMARY

The decline in production and demand for cements, which began in 1943, continued throughout 1944. Total production of 92,152,399 barrels of hydraulic cements was 32 percent below the 1943 figure. This reduction results from respective decreases of 32 percent in the output of portland cement and of a grouping of all other hydraulic cements (natural, masonry, puzzolan, and hydraulic lime). The portland-cement industry operated at 38 percent and the "All other" group at 36 percent of productive capacity in 1944. Mill shipments were 26 percent below 1943 volume and totaled 95,592,155 barrels. Demand for portland cement and the group of all other hydraulic cements, as gaged by shipments, declined nearly one-fourth from 1943. Stocks of all hydraulic cements at mills on December 31, 1944, were 19,976,371 barrels or 15 percent below the quantity on hand at the close of 1943.

The average net mill realization per barrel of portland cement increased 2 cents over 1943 to \$1.59 in 1944, whereas that for "All other hydraulic cements" dropped 4 cents to \$1.24 in 1944.

The decline in the long-term down trend of finished cement, which began in February 1943, continued at an accelerated rate through the first 4 months of 1944. Easement in the rate of decline began in May and continued through the remainder of the year.

Monthly production of cement from January through August 1944 bore little resemblance to the usual peacetime seasonal pattern. Although the trend for January and February was similar to that of a normal period actual production was much greater. This increase is attributed to a larger than usual proportion of construction in the Southern and Far Western States, where structural activity was not seriously curtailed by winter weather. From March to May the month-to-month increases in output were well below the customary seasonal rates of gain. However, in each month from May to August production increased over each preceding month in greater proportions than the usual seasonal pattern. From August to December the production trend followed the typical seasonal pattern. Peak 1944 production was reached in October.

Salient statistics of the cement industry in the United States, 1940-44

	1940	1941	1942	1943	1944
Production of finished cement:					
Portland.....barrels	130,216,511	164,030,559	182,781,184	183,423,788	90,905,696
Masonry, natural, and puzzolan (slag-lime).....barrels	2,534,566	2,875,962	2,580,425	1,830,266	1,246,703
Total production.....do.	132,751,077	166,906,521	185,341,609	185,254,054	92,152,399
Capacity used at portland-cement mills.....percent	51.2	66.3	73.5	55.0	37.8
Production of portland-cement clinker¹					
.....barrels	130,140,932	163,628,857	181,267,461	135,692,400	90,508,803
Active plants:					
Portland.....	152	155	155	153	151
Masonry, natural, and puzzolan (slag-lime).....	12	12	11	10	9
Shipments from mills:					
Portland.....barrels	130,349,786	167,439,237	185,300,884	127,631,859	94,271,881
Value ²	\$190,078,068	\$246,621,914	\$263,257,028	\$200,103,216	\$150,367,764
Per barrel.....	\$1.46	\$1.47	\$1.53	\$1.57	\$1.59
Masonry, natural, and puzzolan (slag-lime).....barrels	2,514,597	2,926,203	2,508,324	1,844,803	1,320,274
Value ²	\$3,386,801	\$3,967,567	\$3,668,169	\$2,357,112	\$1,638,882
Per barrel.....	\$1.35	\$1.36	\$1.46	\$1.28	\$1.24
Total shipments.....barrels	132,864,383	170,365,440	187,809,208	129,478,662	95,592,155
Value.....	\$193,464,869	\$250,589,481	\$286,905,197	\$202,460,328	\$151,996,646
Stocks at mills, Dec. 31:					
Portland:					
Finished cement.....barrels	23,364,657	19,964,918	17,380,273	23,188,975	19,822,700
Clinker.....do.	4,885,941	4,574,528	3,509,336	5,859,170	5,296,103
Masonry, natural, and puzzolan (slag-lime).....barrels	259,866	199,345	253,307	236,770	183,581
Imports.....do.	538,060	43,466	644	13,658	169
Exports.....do.	1,667,595	2,556,234	1,100,826	1,731,956	4,040,405
Apparent consumption.....do.	131,734,848	167,852,672	186,709,026	127,760,364	91,551,919

¹ Compiled from monthly reports by producers.² Value received f. o. b. mill, excluding cost of containers.³ Revised figure.

Monthly shipments in 1944 advanced from the January-February level of slightly more than 5 million barrels to 10,758,000 barrels in August, the largest monthly volume of the year. The volume fell slightly through September and October and rapidly through November and December, reaching the lowest monthly quantity of the year in the latter month.

In 1944 the Middle States displaced the Southern States as the leading cement-consuming region in continental United States (see fig. 1). Consumption in all regions¹ in 1944 as indicated by destination of shipments declined from 1943 levels.

The declines in output and mill shipments of cement in 1944 were less severe than the falling-off in total construction activity, which was estimated on a value basis by the United States Department of Commerce to be 50 percent below 1943. Contracts for engineering construction, as reported by the Engineering News-Record, were approximately one-third below 1943. Portland Cement Association data show that contracts were awarded in 1944 for 32,741,413 square yards of paving—a decline of 54 percent from the 1943 total of 71,089,671 square yards. As reported by the War Production Board, construction work financed by public funds represented 61 percent of the total construction in 1944 compared with 80 percent in 1942 and 1943. The sharpest decrease in construction was in military establishments such as troop housing, airfields, and storage facilities.

War controls on the cement industries were eased during 1944 and were directed primarily toward increasing the maximum price per

¹ Bureau of Mines, Minerals Yearbook, 1942, p. 1204.

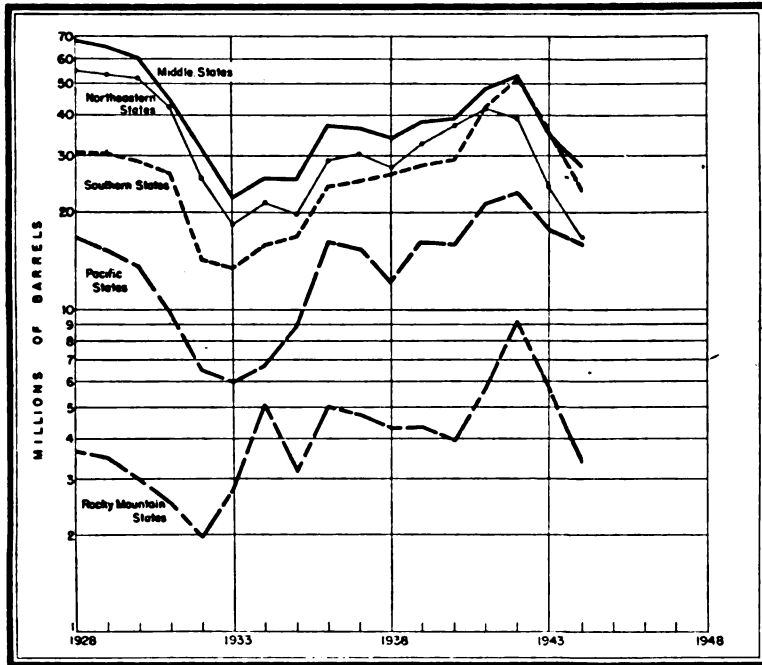


FIGURE 1.—Trends of indicated consumption of portland cement in continental United States, 1928-44, by regions.

barrel to compensate for increased production costs and declining sales volume.

General Limitation Order L-179 on the portland-cement industry, which restricted production of cement to three types—"normal," "high-early-strength," and "moderate-heat"—effective August 23, 1942, was revoked November 25, 1944.

Maximum Price Regulation Order 224 of the Office of Price Administration was amended three times during 1944 to allow price increases in several areas. - Effective April 20, an increase of 20 cents per barrel was granted for the Northeastern States; 10 cents per barrel on August 30 for Michigan, Ohio, West Virginia, western Pennsylvania, part of eastern Kentucky, and western Virginia; and 20 cents per barrel on October 14 for southern California, Arizona, and southeastern Nevada.

The problem of labor shortages and labor turn-over greatly increased costs of production in 1944. Fixed production costs per barrel of output, such as capital investment, plant depreciation, cost of supplies, fuel, and repair parts, also continued to increase as the volume of production fell with the declining demand for cement.

PORTLAND CEMENT

PRODUCTION, SHIPMENTS, AND STOCKS

The annual production of portland cement represents 99 percent of the total output of all hydraulic cements. Thus the general conditions affecting the activity of the portland-cement industry during 1944 were largely those given in the preceding summary.

Finished portland cement produced, shipped, and in stock in the United States, 1943-44

District	Active plants	Production			Shipments from mills						Stocks at mills (Dec. 31)		
		Barrels		Per- cent of change from 1943	1943			1944			Barrels		
		1943	1944		Barrels	Value		Barrels	Value		1943	1944 ¹	
			Total			Average	Total		Average	Total			Average
Eastern Pennsylvania and Mary- land.....	22	18,318,790	11,845,505	-35.3	18,314,984	\$26,014,958	\$1.42	12,992,916	\$19,350,672	\$1.49	4,138,702	2,991,291	-27.7
New York and Maine.....	12	6,595,271	4,180,453	-36.6	6,340,734	9,481,973	1.50	4,639,660	7,263,746	1.57	2,177,654	1,718,447	-21.1
Ohio.....	9	6,412,566	3,911,337	-39.0	6,096,187	8,798,964	1.44	4,129,017	5,957,819	1.44	1,107,258	889,578	-19.7
Western Pennsylvania and West Virginia.....	8	5,013,348	2,699,134	-46.2	4,737,928	6,731,967	1.42	3,272,191	4,695,181	1.43	1,463,059	890,002	-39.2
Michigan.....	10	6,246,291	5,218,620	-16.5	6,430,404	9,285,815	1.44	5,177,176	7,733,185	1.49	1,794,133	1,835,577	+2.3
Illinois.....	4	4,682,139	3,154,196	-32.6	4,307,278	6,657,889	1.55	3,419,815	5,325,769	1.56	914,826	649,207	-29.0
Indiana, Kentucky, and Wisconsin	6	7,625,799	4,809,428	-36.9	6,831,060	10,489,526	1.54	5,699,484	8,685,669	1.52	1,841,330	951,274	-48.3
Alabama.....	6	7,560,462	4,702,911	-37.8	7,398,567	10,943,526	1.49	4,553,664	6,777,741	1.49	473,104	622,351	+31.5
Tennessee.....	6	4,774,089	3,852,618	-19.3	4,579,526	7,342,894	1.60	3,811,780	6,080,921	1.60	590,253	631,091	+6.9
Virginia, Georgia, Florida, and Lou- isiana.....	6	6,526,172	4,625,911	-29.1	6,375,057	10,473,043	1.64	4,678,599	7,723,315	1.65	2,528,426	475,738	-10.0
Iowa.....	5	4,569,899	3,383,082	-26.0	3,912,307	6,335,173	1.62	3,408,616	5,677,787	1.67	1,319,904	1,294,370	-1.9
Eastern Missouri, Minnesota, and South Dakota.....	6	5,262,184	3,749,267	-28.8	4,805,739	7,662,173	1.59	3,455,654	5,562,540	1.61	1,148,407	1,442,020	+25.6
Kansas.....	6	5,958,999	2,818,777	-52.7	5,385,798	8,035,559	1.51	2,866,946	4,454,060	1.55	1,187,431	1,139,292	-4.1
Western Missouri, Nebraska, Okla- homa, and Arkansas.....	6	5,887,848	3,043,933	-48.3	5,280,339	8,470,184	1.60	3,124,301	5,128,708	1.64	931,816	851,008	-8.7
Texas.....	10	9,580,199	6,136,052	-36.0	9,177,392	15,635,708	1.70	6,261,931	11,138,156	1.78	1,135,423	1,009,544	-11.1
Colorado, Wyoming, Montana, Utah, and Idaho.....	8	3,876,825	2,698,558	-30.4	3,788,859	7,227,380	1.91	2,490,136	4,925,139	1.98	406,270	614,692	+51.3
California.....	12	18,468,169	14,650,600	-20.7	17,806,731	27,517,926	1.55	14,977,023	22,645,600	1.51	1,551,070	1,224,647	-21.0
Oregon and Washington.....	9	5,085,788	4,403,320	-13.4	5,190,882	10,707,191	2.06	4,322,283	9,006,058	2.08	446,403	527,440	+18.2
Puerto Rico.....	2	977,950	1,022,434	+4.5	982,087	2,290,957	2.33	990,689	2,225,661	2.25	33,506	65,251	+94.7
Pennsylvania.....	153	133,423,788	901,905,696	-31.9	127,631,859	200,103,216	1.57	94,271,881	150,357,754	1.59	23,188,975	19,822,790	-14.5
Missouri.....	25	19,793,533	12,338,720	-37.7	19,551,388	27,907,226	1.43	13,918,172	20,689,765	1.49	5,034,959	3,455,507	-31.4
	5	4,781,744	3,478,053	-27.3	4,494,943	7,029,285	1.57	3,051,434	4,881,516	1.59	867,920	1,294,539	+48.0

¹ Subject to revision.

² Revised figures.

Production, shipments from mills, and stocks at mills of finished portland cement in the United States in 1944, by months and districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania and Maryland	932	593	700	770	1,083	1,087	1,088	1,164	1,074	1,290	1,117	875
New York and Maine	267	202	133	177	411	321	390	475	456	504	451	389
Ohio	311	216	307	290	285	333	317	418	433	341	359	302
Western Pennsylvania and West Virginia	187	129	150	148	187	243	265	288	288	288	278	196
Michigan	168	110	119	542	524	546	568	580	568	572	550	344
Illinois	251	241	209	176	221	183	177	295	265	433	375	327
Indiana, Kentucky, and Wisconsin	217	261	371	192	234	412	440	626	588	574	489	402
Alabama	374	401	395	425	426	443	412	398	378	394	353	305
Tennessee	271	366	403	353	375	412	419	330	351	310	310	176
Virginia, Georgia, Florida, and Louisiana	277	407	382	389	364	457	452	479	463	392	340	337
Iowa	162	149	47	156	125	248	358	382	361	476	355	443
Eastern Missouri, Minnesota, and South Dakota	300	311	222	210	196	243	293	368	361	455	443	347
Kansas	234	95	112	112	149	276	326	329	352	287	263	255
Western Missouri, Nebraska, Oklahoma, and Arkansas	308	219	164	187	192	204	279	397	227	290	268	307
Texas	430	479	456	575	541	454	530	554	597	520	523	501
Colorado, Wyoming, Montana, Utah, and Idaho	156	147	195	138	206	249	237	248	280	290	280	249
California	1,080	1,000	1,231	1,217	1,260	1,180	1,312	1,188	1,360	1,439	1,182	1,193
Oregon and Washington	317	291	381	368	323	511	454	421	378	319	298	328
Puerto Rico	80	69	100	38	79	104	91	86	93	102	70	111
United States: 1944	6,322	5,686	6,139	6,463	7,181	7,906	8,516	9,003	8,739	9,194	8,304	7,387
	12,560	10,293	11,392	11,239	12,384	11,895	11,880	11,673	11,380	11,189	9,280	8,318
SHIPMENTS												
Eastern Pennsylvania and Maryland	593	649	787	1,154	1,524	1,454	1,255	1,388	1,193	1,295	1,063	641
New York and Maine	176	150	183	369	497	509	447	589	538	587	395	191
Ohio	195	204	212	297	369	421	449	568	487	476	327	123
Western Pennsylvania and West Virginia	153	152	184	242	328	308	330	451	385	378	256	104
Michigan	177	173	192	315	463	573	557	707	686	691	470	172
Illinois	104	107	127	201	254	299	367	538	498	517	275	99
Indiana, Kentucky, and Wisconsin	198	221	285	395	454	540	632	804	732	766	477	198
Alabama	315	284	430	456	463	421	396	391	403	400	359	236
Tennessee	308	366	354	377	500	446	392	296	244	247	190	93
Virginia, Georgia, Florida, and Louisiana	365	326	370	393	460	425	441	450	404	390	400	283
Iowa	55	64	102	186	244	339	374	546	651	565	218	67
Eastern Missouri, Minnesota, and South Dakota	137	161	174	239	278	340	366	439	474	498	267	104
Kansas	149	149	172	199	269	286	263	343	359	340	228	109

Production, shipments from mills, and stocks at mills of finished portland cement in the United States in 1944, by months and districts, in thousands of barrels—Continued

District	January	February	March	April	May	June	July	August	September	October	November	December
SHIPMENTS—continued												
Western Missouri, Nebraska, Oklahoma, and Arkansas.....	119	126	182	204	246	269	398	429	368	378	272	133
Texas.....	449	470	549	622	512	579	575	560	527	579	478	385
Colorado, Wyoming, Montana, Utah, and Idaho.....	96	92	123	174	226	223	230	291	228	310	214	177
California.....	1,089	1,013	1,332	1,145	1,221	1,204	1,362	1,409	1,398	1,388	1,120	1,189
Oregon and Washington.....	299	273	346	346	416	502	416	376	376	372	283	201
Puerto Rico.....	70	75	100	59	60	112	65	100	95	86	78	90
United States: 1944.....	5,047	5,055	6,225	7,373	8,784	9,350	9,283	10,758	10,121	10,263	7,380	4,595
United States: 1943.....	8,641	8,656	10,107	12,757	12,075	12,702	12,411	12,587	12,296	11,288	8,444	5,603
STOCKS (END OF MONTH)												
Eastern Pennsylvania and Maryland.....	4,481	4,425	4,399	4,016	3,565	3,108	3,032	2,817	2,716	2,703	2,755	2,989
New York and Maine.....	2,263	2,315	2,265	2,073	1,988	1,800	1,744	1,530	1,549	1,467	1,523	1,721
Ohio.....	1,231	1,243	1,330	1,323	1,238	1,150	1,018	968	814	679	711	890
Western Pennsylvania and West Virginia.....	1,496	1,473	1,439	1,345	1,200	1,135	1,149	962	865	675	798	889
Michigan.....	1,781	1,718	1,645	1,573	1,434	1,907	1,918	1,791	1,703	1,584	1,664	1,836
Illinois.....	1,060	1,191	1,270	1,245	1,211	1,092	898	1,016	411	323	422	650
Indiana, Kentucky, and Wisconsin.....	1,810	1,849	1,937	1,734	1,514	1,386	1,194	1,048	900	721	746	950
Alabama.....	532	614	614	582	545	568	584	592	566	560	554	632
Tennessee.....	554	555	606	582	457	423	479	513	456	426	548	621
Virginia, Georgia, Florida, and Louisiana.....	438	519	531	527	432	464	504	533	480	482	422	476
Iowa.....	1,436	1,533	1,478	1,443	1,325	1,234	1,215	1,057	869	750	888	1,265
Eastern Missouri, Minnesota, and South Dakota.....	1,316	1,470	1,518	1,489	1,398	1,301	1,227	1,157	1,067	1,023	1,196	1,442
Kansas.....	1,272	1,218	1,159	1,072	951	941	1,004	990	994	941	976	1,122
Western Missouri, Nebraska, Oklahoma, and Arkansas.....	1,120	1,214	1,196	1,179	1,126	1,081	942	909	768	681	677	851
Texas.....	1,116	1,124	1,032	964	1,014	888	843	837	907	848	848	1,010
Colorado, Wyoming, Montana, Utah, and Idaho.....	467	523	564	559	539	555	564	522	476	465	540	612
California.....	1,546	1,535	1,434	1,506	1,545	1,390	1,390	1,158	1,120	1,171	1,233	1,237
Oregon and Washington.....	464	482	511	533	439	449	496	443	446	396	400	527
Puerto Rico.....	43	37	37	15	34	26	52	39	37	62	44	65
United States: 1944.....	24,428	25,073	24,995	24,080	22,455	21,008	20,233	18,482	17,144	16,049	16,983	19,785
United States: 1943.....	21,368	22,985	24,111	22,579	22,861	22,067	21,542	20,620	19,703	19,583	20,419	23,159

In 1944 portland cement was manufactured at 143 plants and shipments were made from 151 plants in 34 States and Puerto Rico. Ten plants shipped from stocks. The leading States, in order of production, were California, Pennsylvania, Texas, Michigan, and Alabama.

Production in 1944 was lower in all Bureau of Mines districts in continental United States than in 1943; the rates of decline ranged from 13 percent in Oregon and Washington to 53 percent in Kansas. The output in Puerto Rico in 1944 increased 44,484 barrels over the previous year.

Shipments from mills during 1944 were below production in seven districts—Michigan, Alabama, Tennessee, Eastern Missouri-Minnesota-South Dakota, Colorado-Wyoming-Montana-Utah-Idaho, Oregon-Washington, and Puerto Rico. These districts, only, show an increase in stocks on December 31, 1944, over the corresponding date of 1943.

Stocks of finished cement were in a favorable condition at the beginning of 1944 and reached a peak in February after which they followed the same seasonal trend as that of the preceding year.

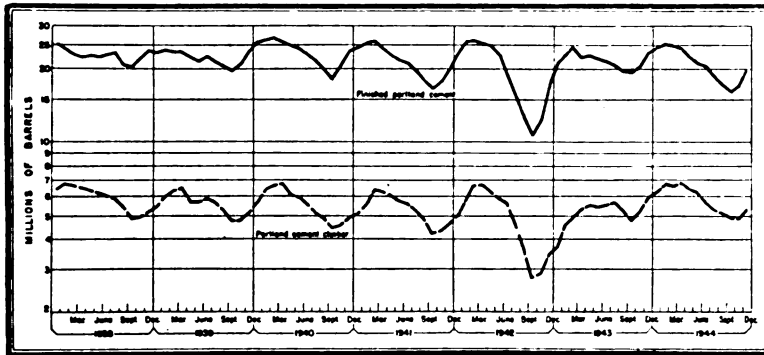


FIGURE 2.—Trends in end-of-month stocks of finished portland cement and portland-cement clinker, 1939-44.

Clinker stocks were also in good supply at the beginning of 1944 and reached their peak in April. They declined from May through November but finished the year with an upward swing in December.

Stocks of finished portland cement and portland-cement clinker at mills in the United States on December 31 and yearly range in end-of-month stocks, 1940-44

	Dec. 31 (barrels)	Range			
		Low		High	
		Month	Barrels	Month	Barrels
1940 Cement.....	23,364,657	October.....	18,008,000	March.....	26,118,000
1940 Clinker.....	4,886,000	do.....	4,470,000	April.....	6,606,000
1941 Cement.....	19,964,918	do.....	16,417,000	March.....	25,988,000
1941 Clinker.....	4,575,000	do.....	4,192,000	do.....	6,276,000
1942 Cement.....	17,380,273	do.....	10,625,000	do.....	25,832,000
1942 Clinker.....	3,509,000	do.....	2,733,000	April.....	6,656,000
1943 Cement.....	123,198,975	do.....	19,583,000	March.....	24,111,000
1943 Clinker.....	5,959,000	January.....	3,771,000	December.....	5,959,000
1944 Cement.....	19,822,790	October.....	16,049,000	February.....	25,073,000
1944 Clinker.....	5,295,000	November.....	4,856,000	April.....	6,687,000

¹ Revised figure.

DOMESTIC CONSUMPTION

Indicated consumption of portland cement in 1944 was above 1943 only in Minnesota, Montana, North Dakota, and Wisconsin and was lower in all other States and the District of Columbia. The changes in regional consumption are illustrated in figure 1.

Destination of shipments of finished portland cement from mills in the United States, 1942-44, by States

Destination	1942 (barrels)	1943 (barrels)	1944	
			Barrels	Percent of change from 1943
Alabama.....	3,237,883	2,354,265	1,193,825	-49.3
Arizona ¹	1,379,825	997,273	577,030	-42.1
Arkansas.....	2,931,890	1,280,188	728,357	-43.1
California.....	17,444,451	13,157,805	12,047,681	-8.4
Colorado.....	2,204,461	951,031	694,056	-27.0
Connecticut ¹	1,996,198	1,094,609	863,538	-21.1
Delaware ¹	348,283	531,444	212,109	-60.1
District of Columbia ¹	1,566,360	1,314,305	667,007	-49.3
Florida.....	3,640,849	2,997,035	1,712,942	-42.8
Georgia.....	2,991,447	2,252,132	1,245,546	-44.7
Idaho.....	570,378	726,204	350,953	-51.7
Illinois.....	9,717,134	5,984,967	4,786,504	-20.0
Indiana.....	6,359,018	3,407,387	2,933,702	-13.9
Iowa.....	2,317,264	2,156,293	1,996,258	-7.4
Kansas.....	4,704,821	3,704,782	1,821,219	-50.8
Kentucky.....	2,613,180	1,836,249	1,258,367	-31.5
Louisiana.....	3,327,152	2,997,504	1,588,674	-47.0
Maine.....	559,731	439,647	248,306	-43.5
Maryland.....	3,036,945	2,620,319	1,595,553	-39.1
Massachusetts ¹	2,715,651	1,467,558	1,084,005	-26.1
Michigan.....	7,069,832	4,825,804	3,770,473	-21.9
Minnesota.....	2,320,780	1,533,605	1,638,274	+6.8
Mississippi ¹	1,467,849	784,009	661,707	-15.6
Missouri.....	3,877,208	2,543,024	1,909,801	-22.5
Montana.....	483,139	249,583	259,048	+3.8
Nebraska.....	4,519,493	2,589,611	1,339,958	-48.3
Nevada ¹	1,551,797	612,035	261,849	-57.2
New Hampshire ¹	456,845	268,157	212,212	-20.9
New Jersey ¹	5,149,525	3,435,432	2,584,923	-24.8
New Mexico ¹	606,841	463,833	382,762	-17.5
New York.....	12,139,320	5,931,517	4,057,926	-31.6
North Carolina ¹	2,420,086	3,197,208	2,709,385	-15.3
North Dakota ¹	291,977	268,290	286,783	+6.9
Ohio.....	8,160,031	6,384,002	4,386,526	-31.3
Oklahoma.....	3,218,926	3,080,350	1,300,453	-57.8
Oregon.....	1,350,988	1,008,276	736,067	-27.0
Pennsylvania.....	10,157,308	6,512,285	4,798,187	-26.3
Rhode Island ¹	963,073	535,352	304,685	-43.1
South Carolina ¹	1,927,768	1,048,924	555,354	-47.1
South Dakota.....	1,055,170	669,736	288,421	-56.9
Tennessee.....	5,282,485	3,002,112	1,882,533	-37.3
Texas.....	11,401,189	7,263,664	5,219,577	-28.1
Utah.....	1,997,820	1,453,948	611,048	-58.0
Vermont ¹	126,412	117,981	116,599	-1.2
Virginia.....	6,435,358	3,495,801	2,434,026	-30.4
Washington.....	4,266,440	3,700,222	3,338,793	-9.8
West Virginia.....	1,481,319	1,190,635	902,932	-24.2
Wisconsin.....	3,056,916	1,801,872	2,259,571	+25.4
Wyoming.....	378,704	383,511	248,343	-35.2
Unspecified.....	17,918	36,319	184,727	+408.6
Continental United States.....	177,385,438	120,658,095	87,308,579	-27.6
Outside continental United States ²	7,915,446	6,973,764	6,963,302	-.2
Total shipped from cement plants.....	185,300,884	127,631,859	94,271,881	-26.1

¹ Non-cement-producing State.

² Direct shipments by producers to foreign countries and to noncontiguous Territories (Alaska, Hawaii, Puerto Rico, etc.) including distribution from Puerto Rican mills.

Destination of shipments of finished portland cement from mills in the United States in 1944, by months, in barrels

Destination	January	February	March	April	May	June	July	August	September	October	November	December
Alabama.....	73,818	70,541	91,420	90,794	101,216	126,488	123,608	121,329	107,447	110,892	99,370	76,960
Arlzona.....	29,034	31,940	34,960	43,892	60,011	45,433	123,608	69,621	98,717	52,472	46,791	49,470
Arkansas.....	7,499	85,747	60,335	62,604	77,540	53,472	53,472	66,643	62,152	58,535	48,791	17,167
California.....	930,828	852,733	992,632	977,558	986,740	1,066,158	1,066,158	1,149,570	1,097,971	1,099,971	893,464	912,025
Colorado.....	38,378	34,962	38,845	41,781	61,098	63,194	63,194	63,323	63,323	93,315	62,857	78,477
Connecticut.....	4,821	11,704	10,463	16,024	18,195	26,825	58,967	37,364	58,967	57,315	94,828	38,662
Delaware.....	45,955	42,006	45,993	52,640	63,044	26,825	64,961	32,003	46,912	19,524	14,632	8,465
District of Columbia.....	13,063	12,006	13,063	13,063	15,750	15,750	15,750	15,750	15,750	15,750	15,750	15,750
Florida.....	98,081	139,295	139,946	153,072	153,072	153,072	153,072	153,072	153,072	153,072	153,072	153,072
Georgia.....	18,670	95,466	112,430	113,072	145,045	110,537	111,862	110,537	110,537	108,174	144,221	115,178
Idaho.....	10,947	35,708	20,776	24,603	29,545	41,827	60,699	76,030	101,636	101,121	97,960	64,622
Illinois.....	17,401	192,128	213,954	268,737	341,018	405,559	617,781	769,393	64,629	714,119	396,143	40,863
Indiana.....	82,695	33,739	122,474	178,841	229,405	263,710	335,553	483,522	400,837	301,409	298,194	141,316
Iowa.....	85,003	73,901	82,640	101,135	116,152	216,472	204,728	339,824	458,869	381,153	121,365	92,907
Kansas.....	71,267	78,083	94,341	97,892	117,277	141,200	144,855	150,832	266,619	207,403	146,001	30,278
Kentucky.....	98,823	127,840	155,214	144,638	122,970	121,430	106,726	141,353	116,107	101,083	147,511	25,366
Louisiana.....	6,767	5,200	6,576	21,010	26,068	31,333	26,726	40,823	33,168	37,385	147,722	112,949
Maine.....	78,926	90,462	119,137	150,596	196,909	189,026	141,929	150,720	119,708	136,782	147,620	5,368
Massachusetts.....	50,008	38,540	49,719	94,454	119,920	100,748	105,620	142,855	146,412	121,307	70,620	77,530
Michigan.....	136,347	126,537	142,417	233,555	350,268	415,715	408,846	500,558	492,477	480,307	332,133	46,046
Minnesota.....	25,067	20,894	45,436	96,217	131,057	191,832	198,810	223,326	267,369	272,501	112,949	141,102
Mississippi.....	29,176	38,540	40,061	48,973	49,577	61,606	60,693	78,500	58,433	72,266	53,174	43,408
Missouri.....	92,892	101,963	123,697	139,603	163,111	166,889	173,497	215,820	183,449	273,849	204,039	41,258
Montana.....	12,835	8,303	12,930	22,903	26,017	25,306	24,450	31,432	28,924	42,985	91,437	11,522
Nebraska.....	27,689	27,331	37,190	45,694	71,013	79,227	186,004	26,990	28,646	202,046	91,437	11,522
Nevada.....	7,605	8,067	20,316	25,013	26,017	25,306	24,450	31,432	28,924	42,985	91,437	11,522
New Hampshire.....	6,810	9,419	12,394	17,593	25,013	41,061	33,091	26,017	28,646	202,046	91,437	11,522
New Jersey.....	144,412	170,540	197,773	240,726	324,140	222,945	224,385	267,728	267,728	246,766	187,659	128,644
New Mexico.....	13,903	18,994	20,488	24,921	26,866	26,866	26,866	26,866	26,866	26,866	26,866	26,866
New York.....	141,192	138,329	179,029	328,851	458,051	478,130	370,071	492,904	477,265	514,234	336,181	116,579
North Carolina.....	191,642	231,530	274,480	328,922	398,335	353,982	305,475	477,768	156,757	134,634	142,904	142,904
North Dakota.....	2,821	1,644	7,902	20,853	35,590	61,233	42,016	27,208	33,102	37,517	13,845	2,889
Ohio.....	211,477	219,588	231,664	330,367	404,710	438,834	421,849	477,890	545,463	490,430	332,424	182,297
Oklahoma.....	68,854	82,662	101,368	119,076	138,001	114,080	111,014	116,340	120,257	129,012	116,065	82,662
Oregon.....	34,449	41,205	52,891	46,060	66,742	78,057	65,069	81,644	81,644	89,543	57,984	42,792
Pennsylvania.....	216,917	214,722	258,827	359,262	461,011	461,011	462,049	624,559	56,231	615,033	397,421	204,318
Rhode Island.....	15,773	15,405	16,574	32,462	25,575	24,462	32,213	37,968	26,231	34,898	17,963	1,559
South Carolina.....	53,275	45,661	40,746	43,276	63,338	62,675	38,194	43,667	37,968	45,748	48,239	36,243
South Dakota.....	3,581	6,402	12,369	22,500	29,807	37,543	35,410	47,703	47,703	54,198	15,487	5,452
Tennessee.....	154,375	172,240	205,660	245,642	295,667	194,745	160,863	161,943	132,873	148,943	395,113	54,429
Texas.....	371,151	395,942	467,618	540,653	644,590	497,245	483,863	473,187	459,398	459,398	395,113	295,123
Utah.....	21,727	1,563	29,829	55,994	64,590	60,071	57,210	62,136	62,136	67,016	9,001	54,277
Vermont.....	3,648	1,563	3,118	8,722	15,156	15,156	9,215	14,788	17,618	17,618	6,681	9,467
Virginia.....	120,340	126,154	151,300	187,510	258,717	248,612	297,260	270,880	220,851	243,403	238,586	96,483

Destination of shipments of finished portland cement from mills in the United States in 1944, by months, in barrels—Continued

Destination	January	February	March	April	May	June	July	August	September	October	November	December
Washington.....	266,447	231,348	314,720	287,806	348,104	402,163	349,973	376,799	284,881	270,569	226,524	153,088
West Virginia.....	31,481	39,189	47,159	65,374	76,212	91,697	89,603	131,907	110,867	106,088	81,014	32,913
Wisconsin.....	48,653	55,118	65,214	130,747	176,238	240,272	234,101	335,671	338,797	373,125	212,880	62,136
Wyoming.....	9,036	9,928	11,646	17,368	23,470	33,286	30,094	27,199	26,370	28,825	19,841	11,404
Unspecified.....	-----	8,482	32,678	15,795	13,683	4,139	-----	24,847	47,263	22,523	26,406	26,605
Continental United States.....	4,639,386	4,734,773	5,620,205	6,846,713	8,191,814	8,718,631	8,682,224	10,154,776	9,515,329	9,554,836	6,783,797	4,034,747
Outside continental United States ¹	407,604	320,227	604,795	526,287	592,186	631,369	600,776	603,224	605,671	708,164	598,203	560,283
Total.....	5,047,000	5,055,000	6,225,000	7,373,000	8,784,000	9,350,000	9,283,000	10,758,000	10,121,000	10,263,000	7,380,000	4,595,000

¹ Shipments by producers to foreign countries and to noncontiguous Territories of the United States (Alaska, Hawaii, Puerto Rico, etc.), including distribution from Puerto Rican mills.

LOCAL SUPPLIES

As parts of some States or areas are commonly supplied from mills of neighboring States within normal shipping range, the data listed in the following table do not indicate areas or States in which a definite shortage of cement existed. The total surplus of producing States in 1944 was distributed as follows: 11,479,948 barrels to non-cement-producing States, 6,131,741 barrels to destinations outside continental United States (excluding local consumption of Puerto Rican production), and 184,727 barrels to unspecified destinations.

Estimated surplus or deficiency in local supply of portland cement in cement-producing States, 1943-44, in barrels

State or division	1943			1944		
	Shipments from mills	Estimated consumption	Surplus or deficiency	Shipments from mills	Estimated consumption	Surplus or deficiency
Alabama.....	7,368,567	2,354,265	+5,014,302	4,553,664	1,193,825	+3,359,839
California.....	17,806,731	13,157,805	+4,648,926	14,977,023	12,047,681	+2,929,342
Illinois.....	4,367,278	5,984,967	-1,617,689	3,419,815	4,786,504	-1,366,689
Iowa.....	3,912,307	2,156,293	+1,756,014	3,408,616	1,996,258	+1,412,358
Kansas.....	5,305,798	3,704,782	+1,601,016	2,866,946	1,821,219	+1,045,727
Michigan.....	6,430,404	4,825,804	+1,604,600	5,177,176	3,770,473	+1,406,703
Missouri.....	4,464,943	2,543,024	+1,921,919	3,061,434	1,969,801	+1,091,633
Ohio.....	6,096,187	6,384,002	-287,815	4,129,017	4,386,526	-257,509
Pennsylvania.....	19,551,388	6,512,285	+13,039,103	13,918,172	4,798,187	+9,119,985
Puerto Rico.....	982,087	1,024,920	-42,833	990,689	831,561	+159,128
Tennessee.....	4,579,526	3,002,112	+1,577,414	3,811,780	1,882,533	+1,929,247
Texas.....	9,177,392	7,263,664	+1,913,728	6,261,931	5,219,577	+1,042,354
Colorado, Montana, Utah, Wyoming, and Idaho.....	3,788,859	3,764,277	+24,582	2,490,136	2,163,450	+326,686
Oregon and Washington.....	5,190,882	4,708,498	+482,384	4,322,283	4,074,860	+247,423
Georgia, Kentucky, Virginia, Florida, and Louisiana.....	7,272,478	13,578,721	-6,306,243	5,276,893	8,239,557	-2,962,664
Indiana, Wisconsin, Minnesota, Nebraska, Oklahoma, South Dakota, and Arkansas.....	11,554,774	14,362,749	-2,807,975	8,619,711	10,488,736	-1,869,025
Maryland and West Virginia.....	3,501,524	3,810,954	-309,430	2,346,935	2,438,485	-151,550
New York and Maine.....	6,340,734	6,371,164	-30,430	4,639,660	4,396,232	+333,428
	127,631,859	105,510,286	+22,121,573	94,271,881	76,475,465	+17,796,416

TRANSPORTATION

The methods of shipping portland cement from producing mills in 1944 show only minor changes from the previous year. The percentage of total shipments moved by boat and truck increased slightly, and the movement by railroads decreased. This trend in methods has been constant since 1942, the first full war year.

There was a sharp drop in the proportion of cement shipped in bulk in 1944 and a corresponding increase in the proportion moved in containers. Despite the paper shortage the percentage moved in paper bags increased from 36.1 in 1943 to 46.2 in 1944, and although the total quantity of cement moved in bulk decreased the percentage of bulk shipments moved by boat increased 1.6 percent.

Shipments of portland cement from mills in the United States, 1942-44, in bulk and in containers, by types of carriers

[Barrels of 376 pounds]

Type of carrier	In bulk		In containers				Total shipments	
			Bags		Other contain- ers ¹	Total		
			Paper	Cloth				
1942 ²	Barrels	Percent	Barrels	Barrels	Barrels	Barrels	Barrels	Per- cent
Truck.....	8,925,440	11.5	8,206,616	6,306,601	-----	14,513,217	23,438,657	12.6
Railroad.....	66,764,363	85.8	49,385,586	42,440,744	8,666	91,834,996	158,599,359	85.6
Boat.....	2,097,849	2.7	690,341	474,678	-----	1,165,019	3,262,868	1.8
Percent of total.....	77,787,652	100.0	58,282,543	49,222,023	8,666	107,513,232	185,300,884	100.0
	42.0	-----	31.4	26.6	(⁴)	58.0	100.0	-----
1943 ²	Barrels	Percent	Barrels	Barrels	Barrels	Barrels	Barrels	Per- cent
Truck.....	7,744,131	14.4	7,595,623	3,170,639	-----	10,766,262	18,510,393	14.5
Railroad.....	44,452,539	82.6	37,688,106	24,345,755	18,513	62,052,374	106,504,913	83.4
Boat.....	1,622,923	3.0	849,969	143,661	-----	993,630	2,616,553	2.1
Percent of total.....	53,819,593	100.0	46,133,698	27,660,055	18,513	73,812,266	127,631,859	100.0
	42.2	-----	36.1	21.7	(⁴)	57.8	100.0	-----
1944 ²	Barrels	Percent	Barrels	Barrels	Barrels	Barrels	Barrels	Per- cent
Truck.....	5,602,744	17.2	7,230,578	2,814,618	-----	10,045,196	15,647,940	16.6
Railroad.....	25,279,796	77.7	35,041,534	15,257,760	9,207	50,308,501	75,588,297	80.2
Boat.....	1,648,229	5.1	1,273,520	113,895	-----	1,387,415	3,035,644	3.2
Percent of total.....	32,530,769	100.0	43,545,632	18,186,273	9,207	61,741,112	94,271,881	100.0
	34.5	-----	46.2	19.3	(⁴)	65.5	100.0	-----

¹ Includes steel drums and iron and wood barrels.

² Includes shipments for Puerto Rico.

³ Includes cement used at mills by producers as follows—1942: 181,642 barrels; 1943: 153,337 barrels; 1944: 112,593 barrels.

⁴ Less than 0.05 percent.

MILL VALUES

The average net mill realization of all portland cement shipped from mills in 1944 advanced to \$1.59 per barrel from \$1.57 in 1943. The gain in average mill return resulted largely from the increased proportion of special cements shipped and the price increases allowed in several sections of the country by the Office of Price Administration.

The composite wholesale price of portland cement, f. o. b. destination, according to the Bureau of Labor Statistics index (1926=100), was 95.8 in 1944, an increase of 2 points over the 1943 figure of 93.8.

Average mill value per barrel, in bulk, of portland cement in the United States, 1940-44

1940.....	\$1.46	1943.....	\$1.57
1941.....	1.47	1944.....	1.59
1942.....	1.53		

CAPACITY OF PLANTS

The aggregate annual capacity of all portland-cement plants in 1944 declined about 2 million barrels from 1943. This decrease was due largely to shortages of manpower, fuel, and the closing and dismantling of one of the mills. Data for 1944 are based on figures of 154 mills throughout the year. The over-all rate of operation in 1944 was at 37.8 percent of total capacity. Plant activity in 1944 was appreciably higher in Virginia, Georgia, Florida, Louisiana, the Pacific Coast States, and Tennessee than in the remainder of the country.

Portland-cement-manufacturing capacity of the United States, 1943-44, by producing districts

District	Estimated capacity (barrels)		Percent of capacity utilized	
	1943	1944	1943	1944
Eastern Pennsylvania and Maryland.....	42,879,516	41,608,420	42.7	28.6
New York and Maine.....	16,944,909	16,740,208	38.9	25.0
Ohio.....	11,817,704	12,308,515	54.3	31.8
Western Pennsylvania and West Virginia.....	13,848,532	13,651,300	36.2	19.8
Michigan.....	13,243,920	13,248,920	47.2	39.4
Illinois.....	9,766,283	9,590,537	47.9	32.9
Indiana, Kentucky, and Wisconsin.....	18,230,027	17,090,027	41.8	28.1
Alabama.....	9,408,243	9,564,707	80.4	49.2
Tennessee.....	7,307,000	7,307,000	66.3	52.7
Virginia, Georgia, Florida, and Louisiana.....	7,338,904	7,338,904	88.9	63.0
Iowa.....	7,330,685	7,330,685	62.3	46.1
Eastern Missouri, Minnesota, and South Dakota.....	12,140,872	11,164,295	43.3	33.6
Kansas.....	8,869,795	8,869,795	67.2	31.8
Western Missouri, Nebraska, Oklahoma, and Arkansas.....	7,550,000	7,550,000	78.0	40.3
Texas.....	14,180,000	14,080,000	67.6	43.6
Colorado, Wyoming, Montana, Utah, and Idaho.....	5,450,000	5,465,000	71.1	49.4
California.....	27,390,000	28,640,000	67.4	51.2
Oregon and Washington.....	7,363,288	7,363,288	69.1	59.8
Puerto Rico.....	1,400,000	1,620,000	69.9	63.1
	242,459,678	240,531,601	55.0	37.8

The number of plants with capacity under 1,000,000 barrels on December 31, 1944, was 42 compared with 44 on the same date of 1943. An increase is reported in 1944 for the plants with capacities between 1 million to 2 million and 3 million to 10 million barrels.

The percentage of capacity used in each month of 1944 was lower than in the corresponding month of 1943. The monthly rate of operation was lowest in February and March of 1944. It began an upswing in April which continued to a peak in October and declined through November and December.

Distribution of portland-cement plants in the United States in 1944, according to annual capacity

Estimated annual capacity; barrels:	Number of plants
Less than 1,000,000.....	42
1,000,000 to 1,999,000.....	80
2,000,000 to 2,999,000.....	21
Between 2,999,000 and 10,000,000.....	11

Percent of capacity used in the finished portland-cement industry in the United States, 1943-44

Month	Monthly		12 months ended—		Month	Monthly		12 months ended—	
	1943	1944	1943	1944		1943	1944	1943	1944
January.....	60	30	74	51	July.....	56	41	67	41
February.....	54	29	74	49	August.....	56	44	64	40
March.....	54	29	73	47	September.....	56	44	62	39
April.....	55	32	72	46	October.....	53	45	59	38
May.....	59	35	70	44	November.....	46	42	56	38
June.....	58	40	69	43	December.....	40	36	54	37

The total capacity of wet-process mills exceeded that of dry plants in 1944 as in the previous year. The closer control of raw materials obtained in the wet-process plants accounts for the greater utilization of the process.

Capacity of portland-cement plants in the United States, 1942-44, by processes

Process	Capacity						Percent of capacity utilized			Percent of total finished cement produced		
	Thousands of barrels			Percent of total								
	1942	1943	1944	1942	1943	1944	1942	1943	1944	1942	1943	1944
Wet.....	122, 432	122, 702	123, 637	49. 2	50. 6	51. 4	77. 7	59. 5	42. 2	52. 1	54. 7	57. 4
Dry.....	126, 419	118, 758	116, 895	50. 8	49. 4	48. 6	69. 3	50. 4	33. 1	47. 9	45. 3	42. 6
	248, 851	242, 460	240, 532	100. 0	100. 0	100. 0	73. 5	55. 0	37. 8	100. 0	100. 0	100. 0

CLINKER PRODUCTION

Production of clinker, the intermediate product of the industry, was 33.3 percent below 1943. However, stocks at the mills on December 31, 1944, although below that of the corresponding date of 1943, were at a satisfactory operating level.

CEMENT

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District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania and Maryland	891	643	772	720	968	1,070	1,083	1,204	1,122	1,233	1,142	922
New York and Maine	286	231	143	161	228	258	341	423	437	437	436	384
Ohio	340	237	309	309	311	332	316	366	373	384	366	336
Western Pennsylvania and West Virginia	118	164	184	184	150	261	288	288	309	330	319	252
Michigan	144	98	112	437	521	516	522	521	532	597	497	397
Illinois	266	232	198	198	212	183	207	170	202	428	389	334
Indiana, Kentucky, and Wisconsin	308	301	398	241	280	283	408	512	568	569	498	538
Alabama	249	401	406	378	452	444	426	389	402	402	378	346
Tennessee	249	317	360	368	399	407	420	336	170	142	227	251
Virginia, Georgia, Florida, and Louisiana	350	386	429	339	379	422	418	449	381	436	386	336
Iowa	237	154	45	127	123	311	345	385	416	435	431	441
Eastern Missouri, Minnesota, and South Dakota	300	296	207	274	396	268	265	413	387	460	372	341
Kansas	223	146	80	64	148	251	340	366	367	333	248	263
Western Missouri, Nebraska, Oklahoma, and Arkansas	357	246	211	231	195	206	206	291	243	291	278	312
Texas	408	415	466	604	554	465	645	690	588	663	428	587
Colorado, Wyoming, Montana, Utah, and Idaho	148	185	202	198	268	300	249	291	277	282	282	239
California	1,226	1,100	1,134	1,214	1,111	1,102	1,118	1,129	1,272	1,291	1,265	1,141
Oregon and Washington	350	330	370	395	365	464	440	446	309	316	362	301
Puerto Rico	73	67	120	40	71	117	86	72	92	121	95	71
United States: 1944	6,038	5,949	6,169	6,547	6,994	7,086	7,984	8,787	8,546	9,015	8,321	7,822
1943	12,808	10,986	11,708	11,603	12,590	11,796	11,974	11,845	10,936	10,716	9,725	9,005
STOCKS (END OF MONTH)												
Eastern Pennsylvania and Maryland	786	860	826	811	666	653	644	685	732	672	700	746
New York and Maine	317	347	365	423	246	228	217	183	178	143	131	129
Ohio	212	229	255	276	300	275	311	293	272	272	273	310
Western Pennsylvania and West Virginia	191	232	261	298	231	225	180	146	159	172	198	258
Michigan	778	764	760	638	630	601	651	482	437	454	397	408
Illinois	67	59	56	66	56	52	41	21	18	7	16	18
Indiana, Kentucky, and Wisconsin	419	459	486	535	541	372	340	219	194	190	188	323
Alabama	130	130	141	91	107	114	122	111	130	135	157	196
Tennessee	344	295	250	254	278	273	245	251	242	165	83	138
Virginia, Georgia, Florida, and Louisiana	108	175	216	215	227	183	151	117	149	139	71	68
Iowa	219	223	220	215	197	262	231	227	190	189	231	230
Eastern Missouri, Minnesota, and South Dakota	178	172	162	229	343	401	377	426	452	466	426	434
Kansas	160	211	174	126	124	100	104	137	138	152	164	201

Production and stocks of portland-cement clinker at mills in the United States in 1944, by months and districts, in thousands of barrels—Con.

District	January	February	March	April	May	June	July	August	September	October	November	December
STOCKS (END OF MONTH)—continued												
Western Missouri, Nebraska, Oklahoma, and Arkansas.....	180	208	251	263	268	301	228	108	103	102	133	140
Texas.....	235	172	183	213	226	230	244	288	290	316	220	207
Colorado, Wyoming, Montana, Utah, and Idaho.....	91	111	118	178	214	283	256	241	230	314	216	209
California.....	1,687	1,689	1,558	1,518	1,325	1,228	1,016	959	842	643	738	696
Oregon and Washington.....	229	272	266	294	342	1,290	260	318	258	280	334	310
Puerto Rico.....	8	7	29	33	27	41	39	27	26	52	80	47
United States: 1944.....	6,329	6,603	6,667	6,667	6,378	6,172	5,577	5,287	5,096	4,962	4,856	5,295
1943.....	3,771	4,566	4,926	5,312	5,574	5,455	5,568	5,688	5,233	4,784	5,233	5,869

Portland-cement clinker produced and in stock at mills in the United States, 1943-44, by processes, in barrels of 376 pounds¹

Process	Plants		Production		Stock (Dec. 31)	
	1943	1944	1943	1944	1943	1944
Wet	86	80	73,438,854	51,338,620	2,457,848	2,597,878
Dry	63	60	62,263,546	39,170,183	3,501,372	2,787,225
	149	140	135,692,400	90,508,803	5,959,220	5,295,103

¹ Compiled from monthly estimates of the producers.

PRODUCTION ACCORDING TO RAW MATERIALS

Portland-cement plants using limestone and clay or shale in 1944 supplied 72.0 percent of the total production compared with 69.2 percent in 1943. The proportion of the production made from cement rock and pure limestone and from blast-furnace slag and limestone declined slightly from 1943, and marl and clay increased 0.6 percent. The continued predominance in 1944 of the mixture of limestone and clay or shale as the leading raw material is attributed to the greater activity of the southern and western mills which use this mixture almost entirely as raw material.

Production and percentage of total output of portland cement in the United States, 1898-1914, 1926, 1929, 1933, 1935, and 1941-44, according to raw materials

Year	Cement rock and pure limestone		Limestone and clay or shale		Marl and clay		Blast-furnace slag and limestone	
	Barrels	Percent	Barrels	Percent	Barrels	Percent	Barrels	Percent
1898	2,764,694	74.9	365,408	9.9	562,092	15.2	-----	-----
1899	4,010,132	70.9	546,200	9.7	1,085,934	19.4	-----	-----
1900	5,960,739	70.3	1,034,041	12.2	1,454,797	17.1	32,443	0.4
1901	8,503,500	66.9	2,042,209	16.1	2,001,200	15.7	164,316	1.3
1902	10,963,178	63.6	3,738,303	21.7	2,220,453	12.9	318,710	1.8
1903	12,493,694	58.9	6,333,403	28.3	3,052,946	13.7	462,930	2.1
1904	15,173,391	57.2	7,526,323	28.4	3,332,873	12.6	473,294	1.8
1906	18,454,902	52.4	11,172,889	31.7	3,884,178	11.0	1,735,343	4.9
1908	23,896,951	51.4	16,532,212	35.6	3,958,201	8.5	2,076,000	4.5
1907	25,859,095	53.0	17,190,697	35.2	3,606,598	7.4	2,129,000	4.4
1908	20,678,663	40.6	23,047,707	45.0	2,811,212	5.5	4,535,300	8.9
1909	24,274,047	37.3	32,219,865	49.6	2,711,219	4.2	5,786,800	8.9
1910	26,520,911	34.6	39,720,320	51.9	3,307,220	4.3	7,001,500	9.2
1911	26,812,129	34.1	40,665,332	51.8	3,314,176	4.2	7,737,000	9.9
1912	24,712,780	30.0	44,607,776	54.1	2,467,368	3.0	10,650,172	12.9
1913	29,333,490	31.8	47,631,863	51.9	3,734,778	4.1	11,197,000	12.2
1914	24,907,047	28.2	50,168,813	56.9	4,038,310	4.6	9,116,000	10.3
1926	44,080,657	26.8	101,637,896	61.8	3,324,408	2.0	15,477,239	9.4
1929	51,077,034	29.9	197,623,602	57.2	4,832,700	2.9	17,112,800	10.0
1933	14,136,171	22.3	143,638,023	68.7	1,402,744	2.2	4,297,251	6.8
1935	23,811,687	31.0	145,073,144	58.8	1,478,569	1.9	6,378,170	8.3
1941	46,534,193	28.4	142,285,699	62.3	3,142,021	1.9	12,068,646	7.4
1942	49,479,304	27.6	115,948,373	63.4	3,009,652	1.7	14,343,846	7.9
1943	29,915,157	22.4	192,810,018	69.2	2,300,636	1.7	8,897,877	6.7
1944	17,609,065	19.4	165,478,178	72.0	2,078,530	2.3	5,738,533	6.3

¹ Includes output of 2 plants using oystershells and clay in 1926; 3 plants in 1929, 1933, and 1935; and 4 plants in 1941, 1942, 1943, and 1944.

RAW MATERIALS

The tonnages of raw materials (exclusive of fuels and explosives) required for the production of finished portland cement are listed in the following table.

Raw materials used in producing portland cement in the United States, 1942-44

	1942	1943	1944
	<i>Short tons</i>	<i>Short tons</i>	<i>Short tons</i>
Cement rock.....	13,538,358	8,564,458	5,119,318
Limestone ¹	26,193,156	28,598,436	19,958,151
Marl.....	903,360	690,456	643,412
Clay and shale ²	5,181,757	4,004,316	2,822,881
Blast-furnace slag.....	809,371	544,064	278,998
Gypsum.....	1,248,448	850,690	597,297
Sand and sandstone ³	567,689	350,941	230,288
Iron materials ⁴	252,200	188,096	123,079
Miscellaneous ⁵	159,104	38,542	22,442
Total.....	58,853,443	43,838,989	29,795,866
Average total weight required per barrel (376 pounds) of finished cement.....	<i>Pounds</i> 644	<i>Pounds</i> 657	<i>Pounds</i> 656

¹ Includes oystershells.² Includes bentonite, diatomaceous shale, and fuller's earth.³ Includes silica and quartz.⁴ Includes iron ore, pyrite cinders and ore, and mill scale.⁵ Includes diatomite, fluorspar, pumelite, flue dust, pitch, red mud and rock, hydrated lime, tufa, cinders, calcium chloride, sludge, grinding aids, and air-entraining compound.**FUELS AND POWER**

The consumption of all types of fuel in 1944 was below that of 1943. This is in line with the lower rate of activity in the cement industry. Stocks of all types of fuel were low and rarely were sufficient at the average monthly consumption rate to maintain operations for more than 2 months without receiving additional supplies.

Finished portland cement produced and fuel consumed by the portland-cement industry in the United States, 1943-44, by processes

Process	Finished cement produced			Fuel consumed ¹		
	Plants	Barrels of 376 pounds	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (cubic feet)
1943						
Wet.....	86	73,019,416	54.7	2,957,055	1,397,442	34,720,918,557
Dry.....	63	60,404,372	45.3	2,894,368	1,554,720	17,026,806,000
	149	133,423,788	100.0	5,851,423	2,952,162	51,747,724,567
1944						
Wet.....	82	51,380,771	56.5	1,956,865	1,525,242	23,476,342,004
Dry.....	61	39,524,925	43.5	1,781,822	1,050,430	12,111,214,440
	143	90,905,696	100.0	3,738,687	2,575,672	35,587,556,444

¹ Figures compiled from monthly estimates of the producers.² Includes 8,539 tons of anthracite and 5,342,884 tons of bituminous coal.³ Includes 21,956 tons of anthracite and 3,716,731 tons of bituminous coal.

Portland cement produced in the United States, 1943-44, by kinds of fuel

Fuel	Finished cement produced			Fuel consumed ¹		
	Number of plants	Barrels of 376 pounds	Per cent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (cubic feet)
1943						
Coal.....	89	72,745,601	54.5	4,665,946	-----	-----
Oil.....	13	10,121,934	7.6	-----	2,471,517	-----
Natural gas.....	11	10,255,676	7.7	-----	-----	15,179,674,200
Coal and oil.....	10	10,108,735	7.6	697,989	50,907	-----
Coal and natural gas.....	14	12,889,090	9.7	325,618	-----	15,269,282,100
Oil and natural gas.....	7	11,904,336	8.9	-----	260,364	15,388,933,857
Coal, oil, and natural gas.....	5	5,398,416	4.0	161,870	169,374	5,909,634,400
	149	133,423,788	100.0	5,851,423	2,952,162	51,747,724,557
1944						
Coal.....	86	49,279,289	54.2	3,095,944	-----	-----
Oil.....	11	8,154,580	9.0	-----	1,758,259	-----
Natural gas.....	12	6,538,785	7.2	-----	-----	10,247,327,540
Coal and oil.....	9	7,626,823	8.4	478,493	414,576	-----
Coal and natural gas.....	14	7,798,219	8.6	150,157	-----	11,547,189,904
Oil and natural gas.....	6	8,791,018	9.6	-----	334,027	9,885,310,000
Coal, oil, and natural gas.....	5	2,716,682	3.0	14,093	68,810	3,907,729,000
	143	90,905,696	100.0	3,738,687	2,575,672	35,687,556,444

¹ Figures compiled from monthly estimates of the producers.² Average consumption of fuel per barrel of cement produced was as follows: 1943—Coal, 128.3 pounds; oil, 0.2442 barrel; natural gas, 1,480 cubic feet. 1944—Coal, 125.6 pounds; oil, 0.2156 barrel; natural gas, 1,567 cubic feet.³ Includes 8,539 tons of anthracite and 5,842,884 tons of bituminous coal.⁴ Includes 21,956 tons of anthracite and 3,716,731 tons of bituminous coal.*Electric energy used at portland-cement-producing plants in the United States, 1943-44, by processes, in kilowatt-hours*

Process	Electric energy used						Finished cement produced (barrels)	Average electric energy used per barrel of cement produced (kilowatt-hours)
	Generated at portland-cement plants		Purchased		Total			
	Active plants	Kilowatt-hours	Active plants	Kilowatt-hours	Kilowatt-hours	Per cent		
1943								
Wet.....	30	562,003,714	74	1,358,769,419	1,920,773,133	56.6	73,019,416	26.3
Dry.....	34	910,805,458	51	559,848,279	1,470,653,737	43.4	60,404,372	24.3
	64	1,472,809,172	125	1,918,617,698	3,391,426,870	100.0	133,423,788	25.4
Percent of total electric energy used.....		43.4		56.6	100.0			
1944								
Wet.....	27	436,937,724	75	912,052,832	1,348,990,556	57.6	52,157,819	25.9
Dry.....	31	589,948,127	51	404,209,961	994,158,088	42.4	38,747,877	25.7
	58	1,026,885,851	126	1,316,262,793	2,343,148,644	100.0	90,905,696	25.8
Percent of total electric energy used.....		43.8		56.2	100.0			

TYPES OF CEMENT

A break-down of total production of portland cement in 1944 by various types is presented in the following table. Although the overall production and shipments of cement in 1944 was lower than the previous year, production and demand for oil-well, portland-puzzolan, and miscellaneous types of cement was greater in 1944.

Prepared masonry mortars.—Production of these mixed materials in 1944 from 68 plants totaled 2,267,333 barrels and shipments 2,210,262 barrels, valued at \$3,493,971 an average mill realization of \$1.58 per barrel. These data are not included in the statistics of this chapter, but the portland cement used in producing the mixtures is included.

Portland cement produced and shipped in the United States, 1940-44, by types

Kind and year	Active plants	Production (barrels)	Shipments		
			Barrels	Value	
				Total	Average
General use and moderate heat (types I and II):					
1943 ¹	153	123,490,667	118,347,297	\$182,682,614	\$1.54
1944 ²	151	83,576,685	86,933,387	135,564,313	1.56
High-early-strength (type III):					
1940.....	88	4,478,797	4,401,449	8,243,315	1.87
1941.....	90	6,063,638	6,123,224	11,443,792	1.87
1942.....	87	7,523,647	7,065,700	13,683,665	1.94
1943.....	95	6,816,671	6,299,190	12,040,467	1.91
1944.....	97	5,135,264	5,190,092	10,278,215	1.96
Low-heat (type IV):					
1943 ¹	4	1,710,617	1,687,277	2,316,755	1.37
1944.....	4	441,368	400,998	554,684	1.38
Sulfate-resisting (type V):					
1940.....	11	193,348	200,090	316,280	1.56
1941.....	9	342,400	363,885	544,767	1.54
1942.....	8	79,835	77,015	136,939	1.78
1943.....	5	24,419	20,697	40,933	1.96
1944.....	4	100	1,647	3,280	1.99
Oil-well:					
1940.....	22	711,348	719,022	1,365,840	1.90
1941.....	19	786,167	806,364	1,550,301	1.92
1942.....	17	537,541	552,157	1,100,296	1.99
1943.....	16	630,412	544,436	1,050,178	1.93
1944.....	15	938,872	931,371	1,802,361	1.94
White:					
1940.....	3	(³)	(³)	(³)	(³)
1941.....	4	538,752	549,298	2,191,289	3.99
1942.....	5	345,613	306,120	1,214,422	3.97
1943.....	6	318,470	335,110	1,340,201	4.00
1944.....	6	302,543	322,443	1,303,440	4.04
Portland-puzzolan:					
1940.....	10	413,870	412,143	552,830	1.34
1941.....	8	441,500	439,354	632,713	1.44
1942.....	7	324,002	329,637	465,627	1.41
1943.....	4	215,026	221,182	311,230	1.41
1944.....	4	290,013	244,858	337,250	1.38
Miscellaneous:⁴					
1940.....	13	580,502	577,579	755,764	1.31
1941.....	14	668,655	667,206	1,058,108	1.59
1942.....	12	242,170	269,705	488,083	1.74
1943.....	23	217,506	176,670	320,838	1.82
1944.....	21	220,851	247,085	514,211	2.08

¹ Figures reported separately for the first time in 1943.

² Includes air-entrained and Vinsol resin cements classed as modified cements by producers.

³ Bureau of Mines not at liberty to publish figures separately.

⁴ Revised figure.

⁵ 1940-42: Includes hydroplastic and plastic portland cements; 1943-44: Includes hydroplastic, plastic, and waterproofed cements.

NEW DEVELOPMENTS

Several cement mills have changed to the manufacture of chemical lime through their rotary kilns. However, the Manitowoc Portland Cement Co., Manitowoc, Wis., a subsidiary company of the Medusa Portland Cement Co., Cleveland, Ohio, is manufacturing simultaneously chemical lime for war industries and standard portland cement.²

New trends in the cement industry in 1944 were directed primarily toward war-born products developed because of shortages of other materials. Some of these are concrete beams to replace steel in the construction of industrial buildings, concrete tanks substituted for steel tanks in many applications, increased manufacture of concrete burial vaults with little or no reinforcing steel, and concrete joist floors which have replaced wood construction. A high-strength lightweight concrete has been developed in the Northwestern University Technological Institute.³ The exceptional strength is obtained by compressing the concrete and reducing the amount of water in the mix.

Interest in air-entraining cement also continues to grow, and more confidence seems to be placed in this relatively new type concrete. Investigations concerning the type and method of adding the air-entraining agents by the Central Concrete Laboratory of the United States Engineers, Mount Vernon, N. Y., have shown that the variability of the air content can be reduced by using neutralized Vinsol resin (sodium resinate) rather than unneutralized flake Vinsol resin.⁴ Experiments concerning the mesh size of sands that provide the required amount of air entrapment have also been made.⁵

The Permanente Cement Corp. (California) has set a new record for the industry by making 20,328 barrels of cement in a 24-hour period. The former record was 18,830 barrels.

NATURAL, MASONRY (NATURAL), AND PUZZOLAN CEMENTS

Production and shipments of the group of hydraulic cements other than portland in 1944 decreased 32 and 29 percent, respectively, from the previous year's total. Stocks also decreased and were 32 percent below the 1943 total. Producers reported the consumption of 17,845 short tons of coal and of gas equivalent to approximately 107 short tons of coal.

Natural, masonry (natural), and puzzolan (slag-lime) cements produced, shipped, and in stock at mills in the United States, 1940-44

Year	Production		Shipments		Stock (Dec. 31)
	Active plants	Barrels (376 pounds)	Barrels (376 pounds)	Value	Barrels (376 pounds)
1940.....	12	2,534,566	2,514,597	\$3,386,801	259,868
1941.....	12	2,875,962	2,926,203	3,967,567	199,365
1942.....	11	2,560,425	2,508,324	3,668,169	253,307
1943.....	10	1,830,266	1,846,803	2,357,112	227,152
1944.....	9	1,246,703	1,320,274	1,638,892	163,581

¹ Revised figure.

² Nordberg, B., Make Lime and Cement Simultaneously: Rock Products, vol. 47, No. 6, 1944, pp. 60-63.

³ Money, G. A., Develop Concrete of Unusual Strength: Rock Products, vol. 47, No. 9, 1944, p. 41.

⁴ Wuerrpel, C. E., Weiner, A., Uses of Air-Entraining Agents for Concrete: Eng. News-Record, vol. 133, No. 2, 1944, pp. 111-112.

⁵ Kennedy, H. L., Entrained Air; Its Effect on the Constituents of Portland Cement Concrete: Eng. News-Record, vol. 133, No. 2, 1944, p. 112.

POSTWAR OUTLOOK

Although there was little increase in cement-plant capacity during the war, available facilities enabled the industry to attain an all-time high production of more than 185 million barrels during the intensive war-construction period of 1942. Thereafter production declined greatly, but despite manpower shortages and shrinking markets the plants as a whole have been kept in operating condition. The industry is therefore ready to take advantage of the anticipated enormous postwar building program which the F. W. Dodge Corp. has estimated will exceed 15 billion dollars in the region east of the Rocky Mountains. Furthermore the planned 3-year program of postwar highway construction exceeds 3 billion dollars. The magnitude of the cement market implied by these figures may be estimated in the light of studies made by the Public Works Administration on the proportion of the construction dollar that is spent for cement. These studies show that for the construction of buildings the percentage is 4, for sewage-disposal systems 9, for streets and roads 10, and for reclamation projects 11.

In view of the postwar construction plans of the Government and industry, termination of the war will effect almost immediately an expansion in the production of cement.

The ruling of the Federal Trade Commission abrogating the basic point price system may lead to greater decentralization of cement plants or to the production of clinker only at the present large mills, with shipment of clinker to grinding mills nearer the established markets.

Closer control of raw materials and more exact specifications will be expected for the postwar industry, but because of the expected sellers' market for the years immediately following the war, purchasers probably will accept the current five standard types of cement.

Although increased production ordinarily tends to lower prices no reduction is expected in the immediate postwar period because of the increased costs of fuel and power and the probable increase in labor costs.

FOREIGN TRADE *

With the cessation of hostilities in Europe import and export figures from all countries may be released.

Imports.—Imports of all hydraulic cements except white nonstaining portland cement, 1942-44, are listed by country of origin in the second table following. Imports of white nonstaining cement totaled 304 barrels valued at \$1,201 in 1942, but in 1943 and 1944 no imports of this type of material were received.

Hydraulic cement imported for consumption in the United States, 1940-44

Year	Barrels	Value	Year	Barrels	Value
1940.....	538,060	\$506,191	1943.....	13,658	\$55,500
1941.....	43,466	59,048	1944.....	169	418
1942.....	644	2,020			

* Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

*Roman, portland, and other hydraulic cements imported for consumption in the United States, 1942-44, by countries*¹

Country	1942		1943		1944	
	Barrels	Value	Barrels	Value	Barrels	Value
Canada.....	281	\$695	13,652	\$55,536	169	\$417
Egypt.....			6	10		
Guatemala.....					(?)	1
Mexico.....	59	124	1	2		
	340	819	13,658	55,548	169	418

¹ Excludes "white, nonstaining, and other special cement."

² Less than 1 barrel.

Exports.—Exports of cement to foreign countries in 1944 were greater than in any other recent year. The increase is attributed largely to expanded requirements of the Latin American countries, the principal United States export market, and to a sharp rise in demands from Iran, Arabia Peninsular States, and the State of Bahrein. Exports of hydraulic cement from 1940 through 1944 and exports by countries of destination for 1942 through 1944 are given in the following tables.

Hydraulic cement exported from the United States, 1940-44

Year	Barrels	Value	Percent of total shipments from mills
1940.....	1,667,595	\$3,294,118	1.3
1941.....	2,556,234	5,663,037	1.6
1942.....	1,100,826	2,707,217	.6
1943.....	1,731,956	4,654,862	1.3
1944.....	4,040,405	10,049,243	4.4

Hydraulic cement exported from the United States, 1942-44, by countries

Country	1942		1943		1944	
	Barrels	Value	Barrels	Value	Barrels	Value
North America:						
Bermuda.....	10,115	\$23,407	4,767	\$9,585	15,503	\$33,352
Canada.....	41,162	139,108	24,579	93,867	22,064	93,863
Central America:						
British Honduras.....	1,288	3,056	3,214	6,600	6,282	14,057
Costa Rica.....	106,092	241,245	127,658	305,120	59,412	131,701
El Salvador.....	11,472	24,971	85,965	211,123	41,983	104,669
Guatemala.....	177	892	8,906	28,319	2,408	11,686
Honduras.....	12,337	27,418	32,698	82,274	37,128	91,197
Nicaragua.....	22,099	45,723	13,923	30,192	3,203	9,744
Panama:						
Canal Zone.....	115,427	233,768	35,823	78,268	75,185	155,950
Republic of.....	59,281	128,445	139,026	319,493	249,371	577,185
Mexico.....	81,098	192,321	347,582	842,241	560,554	1,461,926
Newfoundland and Labrador.....	59	159	313	902	75	314
West Indies:						
British:						
Bahamas.....	9,780	25,982	39,751	86,253	19,635	50,560
Jamaica.....	37,986	89,553	31	128	3,107	7,349
Leeward Islands.....	755	1,584	2,272	4,203	13,688	30,512
Trinidad and Tobago.....	4,669	9,405	15,342	31,626	15,840	36,681
Windward Islands.....	20,100	42,813	1,075	2,310	8,150	19,325
Other.....	3,272	10,906	9,326	27,444		
Cuba.....	19,793	106,488	66,499	239,721	387,043	845,548
Curacao (N. W. I.).....	122,767	324,968	73,227	179,503	82,048	181,252
Dominican Republic.....	48,081	108,355	118,737	305,111	233,750	550,839
French.....	31,453	46,977	9,906	28,037	64,376	149,874
Haiti.....	18,543	41,637	48,011	117,990	31,222	73,244
Other North America.....	5,962	13,144	260	621	2,537	7,286
	784,668	1,882,415	1,208,891	3,030,931	1,934,564	4,638,114

Hydraulic cement exported from the United States, 1942-44, by countries—Continued

Country	1942		1943		1944	
	Barrels	Value	Barrels	Value	Barrels	Value
South America:						
Argentina.....	3, 130	\$13, 670	11, 267	\$67, 245	4, 491	\$26, 880
Bolivia.....	585	765	7, 776	24, 899	95, 615	222, 847
Brazil.....	35, 188	96, 770	85, 594	292, 955	505, 554	1, 421, 247
Chile.....	56, 772	133, 673	5, 545	38, 809	35, 446	111, 946
Colombia.....	9, 488	20, 807	25, 777	151, 185	223, 866	527, 138
Ecuador.....	5, 599	13, 525	2, 613	13, 972	10, 498	32, 398
Paraguay.....			2, 480	10, 360	775	3, 152
Peru.....	2, 223	12, 205	4, 501	27, 266	20, 868	54, 913
Surinam.....	28, 664	67, 663	30, 754	75, 730	29, 031	61, 213
Uruguay.....	753	4, 126	2, 863	16, 096	2, 278	12, 251
Venezuela.....	109, 666	265, 404	319, 897	821, 467	1, 075, 596	2, 676, 180
Other South America.....	3, 022	11, 694	1, 795	4, 427	21, 360	47, 844
	255, 100	640, 302	498, 862	1, 544, 441	2, 025, 378	5, 196, 019
Europe:						
Portugal.....	250	1, 275	500	2, 601	253	1, 412
Other Europe.....	26	167			104	152
	276	1, 442	500	2, 601	357	1, 564
Asia:						
Arabia Peninsular States.....			250	830	19, 793	53, 747
Iran.....	628	2, 796	638	12, 019	42, 560	102, 518
Palestine.....			79	1, 009	122	1, 678
State of Bahrain.....	1, 193	5, 578	777	7, 405	4, 480	16, 886
Other Asia.....	22, 739	44, 778	1	109	(1)	(1)
	24, 560	53, 152	1, 745	21, 372	(1)	(1)
Africa:						
Egypt.....	2, 059	4, 798	3, 437	5, 820	200	1, 100
Liberia.....	33, 261	118, 549	16, 555	35, 027	8, 487	18, 257
Union of South Africa.....	717	5, 298	384	1, 940	292	1, 760
Other Africa.....	155	622	1, 441	12, 317	3, 341	12, 524
	36, 192	129, 267	21, 917	55, 104	12, 320	33, 641
Oceania:						
French Oceania.....	30	639	40	352	(1)	(1)
Other Oceania.....			1	61	(1)	(1)
	30	639	41	413	(1)	(1)
	1, 100, 826	2, 707, 217	1, 731, 956	4, 654, 862	4, 040, 405	10, 048, 243

¹ Data not available for publication.

Shipments of hydraulic cement to noncontiguous Territories of the United States, 1942-44, are shown in the following table. American Samoa was a new export market in 1944.

Domestic hydraulic cement shipped to noncontiguous Territories of the United States, 1942-44

Territory	1942		1943		1944	
	Barrels	Value	Barrels	Value	Barrels	Value
Alaska.....	361, 804	\$877, 447	52, 422	\$139, 749	27, 832	\$79, 589
American Samoa.....					27	59
Hawaii.....	426, 118	1, 003, 514	372, 958	931, 896	111, 878	239, 079
Puerto Rico.....	158, 776	330, 093	1, 841	10, 619	2, 583	13, 890
Virgin Islands.....	3, 886	10, 963	17, 053	81, 065	20, 774	66, 565

WORLD PRODUCTION

Production of cement in 1944 continued to decline in the United States and Canada as in the previous year. However, production increased in Mexico and in the Central and South American countries.

World production of hydraulic cements, 1939-44, by countries, in metric tons¹

[Compiled by B. B. Waldbauer]

Country	1939	1940	1941	1942	1943	1944
North America:						
Canada.....	909,875	1,200,143	1,328,587	1,448,818	1,159,286	1,140,263
Cuba.....	(²)	(²)	154,618	165,189	169,609	173,750
Guatemala.....	(²)	(²)	(²)	(²)	(²)	(²)
Mexico.....	400,784	484,992	537,464	588,476	578,253	(²)
Nicaragua.....	(²)	(²)	(²)	620	10,627	(²)
United States.....	21,267,269	22,640,675	28,465,880	31,609,981	23,067,914	15,716,820
South America:						
Argentina.....	1,127,608	1,062,279	1,168,281	1,076,858	957,076	(²)
Bolivia.....	(²)	24,285	(²)	22,579	22,675	(²)
Brazil.....	697,793	743,634	767,506	752,839	747,409	809,908
Chile.....	340,758	385,091	359,720	364,684	374,747	(²)
Colombia.....	167,000	188,000	210,912	207,793	226,304	³ 235,000
Ecuador.....	14,249	16,481	17,014	19,802	27,860	35,116
Peru.....	119,986	124,480	167,872	188,882	208,599	246,840
Uruguay.....	173,500	167,880	179,066	(²)	(²)	(²)
Venezuela.....	38,399	87,068	115,415	121,833	111,721	119,670
Europe:						
Albania.....	(²)	(²)	(²)	(²)	(²)	(²)
Belgium.....	2,551,756	(²)	(²)	(²)	(²)	(²)
Bulgaria.....	⁴ 180,000	(²)	(²)	(²)	(²)	(²)
Czechoslovakia.....	⁴ 276,000	⁴ 214,000	⁴ 300,000	(²)	(²)	(²)
Denmark.....	696,000	441,000	(²)	(²)	(²)	(²)
Estonia.....	77,000	(²)	(²)	(²)	(²)	(²)
Finland.....	563,000	301,000	(²)	(²)	(²)	(²)
France.....	(²)	(²)	3,402,000	2,462,000	2,934,000	1,467,000
Germany.....	(²)	(²)	(²)	(²)	(²)	(²)
Austria.....	(²)	(²)	(²)	(²)	(²)	(²)
Greece.....	(²)	(²)	(²)	(²)	(²)	(²)
Hungary.....	(²)	(²)	(²)	(²)	(²)	(²)
Ireland.....	261,000	272,000	294,000	(²)	(²)	(²)
Italy.....	5,111,610	(²)	(²)	(²)	(²)	(²)
Latvia.....	164,601	(²)	(²)	(²)	(²)	(²)
Netherlands.....	541,000	(²)	(²)	(²)	(²)	(²)
Norway.....	390,000	(²)	(²)	(²)	(²)	(²)
Poland.....	(²)	(²)	(²)	(²)	(²)	(²)
Portugal.....	297,000	273,000	272,000	⁵ 186,967	246,799	⁵ 252,000
Rumania.....	531,000	400,000	(²)	(²)	(²)	(²)
Spain.....	1,194,481	1,557,878	1,639,923	1,646,280	1,701,520	1,627,773
Sweden.....	1,184,991	700,749	645,023	823,890	(²)	(²)
Switzerland.....	(²)	650,000	711,000	439,000	367,000	430,000
U. S. S. R.....	5,700,000	5,800,000	(²)	(²)	(²)	(²)
United Kingdom.....	(²)	(²)	(²)	(²)	(²)	(²)
Yugoslavia.....	663,000	(²)	(²)	(²)	⁶ 750,000	(²)
Asia:						
China.....	⁶ 540,000	682,500	(²)	(²)	(²)	(²)
Manchuria.....	(²)	(²)	(²)	(²)	(²)	(²)
Chosen.....	(²)	(²)	(²)	(²)	(²)	(²)
Hong Kong.....	³ 110,000	(²)	(²)	(²)	(²)	(²)
India, British.....	(²)	(²)	(²)	(²)	(²)	(²)
Indochina.....	305,800	278,500	(²)	(²)	(²)	(²)
Iran.....	(²)	(²)	(²)	(²)	(²)	(²)
Japan and colonies.....	5,074,000	⁴ 4,250,000	(²)	(²)	(²)	(²)
Netherlands Indies.....	³ 170,000	(²)	(²)	(²)	(²)	(²)
Pakistan.....	112,350	148,487	114,841	218,577	166,804	176,499
Philippine Islands.....	(²)	(²)	(²)	(²)	(²)	(²)
Syria and Lebanon.....	227,285	91,653	(²)	250,000	³ 200,000	(²)
Thailand (Siam).....	⁷ 92,000	⁷ 116,864	(²)	(²)	(²)	(²)
Turkey.....	283,624	267,064	272,919	210,855	(²)	(²)
Africa:						
Algeria.....	(²)	(²)	(²)	(²)	(²)	95,000
Belgian Congo.....	35,000	24,700	42,586	64,340	(²)	(²)
Egypt.....	371,941	360,832	420,107	420,980	322,859	(²)
Eritrea.....	36,000	15,000	9,000	25,000	27,500	38,000
Morocco, French.....	(²)	(²)	(²)	(²)	³ 140,000	(²)
Mozambique.....	27,618	27,893	27,260	24,941	30,647	(²)
Tunisia.....	66,500	61,800	57,200	56,300	(²)	(²)
Union of South Africa.....	948,664	831,018	878,000	(²)	³ 1,000,000	(²)
Oceania:						
Australia.....	881,778	879,000	874,000	(²)	(²)	(²)
New Zealand.....	235,000	218,000	(²)	(²)	³ 217,000	(²)
	⁸ 93,000,000	⁸ 81,000,000	⁸ 77,000,000	⁸ 72,000,000	⁸ 81,000,000	(²)

¹ Data cover all hydraulic cements.² Data not available; estimate included in total, except for 1944.³ Estimate.⁴ Slovakia only.⁵ January to September, inclusive.⁶ Shipments.⁷ Year ended Mar. 31 of year stated.⁸ Year ended June 30 of year stated.

REVIEW BY COUNTRIES

Brazil.—On January 15, 1944, the import duty on portland cement and roman cement received in Brazil was suspended for 90 days. Domestic production of cement comes largely from the States of São Paulo and Rio de Janeiro. The first plant producing white portland cement in Brazil began operations in August 1943. Inadequate fuel supplies and transportation problems are still a limiting factor in the production of cement in Brazil.

Chile.—The cement requirements of Chile continue to increase. As the war shut off the supply of new equipment, the property of Thomas A. Edison, Inc., at Piscataway, N. J., was purchased and shipped to Chile to be used in the construction of a cement plant. Construction was begun early in March 1944 on the new plant at Juan Soldada, near La Serena, Chile. The supply of raw material at this locality is believed to be sufficient for 70 years at an annual consumption rate of 200,000 metric tons.

Colombia.—By 1941 the production of cement by domestic plants was sufficient for the country's needs. Cement was not imported in 1941-42, and an export market was opened in 1943. In 1944 the output of cement again increased as new plants were built in the interior of the country.

India.—It is reported that the cement-production capacity of India is about 2,500,000 tons a year, which more than doubles the prewar output. There are 23 factories producing cement, but only about 10 percent of current production is available for civilian consumption as the bulk of the output is required for public works and defense requirements.

Mexico.—The United States Mexican Commission for Economic Cooperation which was created in May 1943, announced during 1944 a Nation-wide development program for the portland cement industry in Mexico. Five existing plants have been enlarged, and new plants are under construction at Cuernavaca, Lagunas, Merida, Monterrey, Nuevo, and Orzaba.

Spain.—The output of cement in Spain began an upswing in 1941 which continued through 1943 the latest year for which figures are available. However, it is believed that production continued to expand through 1944.

Sweden.—Production of cement in Sweden decreased from 1939 through 1941. However, production and consumption began an upswing in 1942 that continued through 1944. Further expansion of domestic production is limited by the lack of coal.

Turkey.—It has been reported that the Government of Turkey took over all the cement plants in 1944. An upswing in output began in 1942 and continued through 1944. Two new plants, one at Ankara and the other at Sivas, were completed in 1943.

U. S. S. R.—New cement plants were constructed in Dneprodzerzhinsk in th Ukraine, and at Novosibirsk in 1944. Another plant at Krasnoyarsk, Krai, and two technical schools at Novosibirsk to restore and operate cement plants are expected to be in operation early in 1945.

Venezuela.—The importation of portland cement into Venezuela was again encouraged in 1944 to relieve the continued shortage.

The lifting of import duties on cement, which became effective on December 7, 1942, was continued to May 7, 1944, and a reduction in

wharfage charges has been made to establish a uniform charge on cement entering the various Venezuelan ports. Plans for several plants are being considered. The new plants when completed will not only make the country self-sufficient but will also furnish a considerable quantity for export.

Yugoslavia.—The cement production in Yugoslavia comes from 5 plants in Dalmatia. The chief raw material is Dalmatian cement marl. A recent report states that a process has been discovered that transforms low-grade bauxite into a quick-setting cement known locally as "electro cement." Annual production is reported to be 750,000 metric tons per year.

STONE

By OLIVER BOWLES AND NAN C. JENSEN

SUMMARY OUTLINE

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GENERAL CONDITIONS

Sales of crushed and dimension stone combined (155,579,580 tons) were 9 percent less in 1944 than in 1943 and 21 percent less than the all-time high record of 1942. The total value of sales (\$175,642,157) was 5 percent less than in 1943. Sales of crushed and broken stone continued to decline, as Government construction was small, highway programs were suspended pending termination of the war, and private construction was almost negligible. Dimension stone sales dropped to the lowest point in the recorded history of the industry. Such a condition was not unexpected because the types of construction required for military needs demand minimum quantities of building stone, and both private and Government construction of large permanent buildings in which stone is normally used was almost at a standstill. The total value of sales, however, increased. Crushed and broken stone output declined 9 percent in quantity and 6 percent in value. Dimension stone (including slate) declined 25 percent in quantity but increased 8 percent in value.

This chapter follows the general plan introduced in 1938 whereby crushed stone and dimension stone are considered separately, except in the introductory general tables.

The tables of this report give the quantities sold or used by producers and the values f. o. b. quarries and mills. Stone quarried and used by producers is considered as sold and is included in the statistics of sales. The data, however, do not include stone made into abrasives (such as grindstones) or that used in making lime and cement. These materials are reported in terms of finished products in the Abrasive Materials, Lime, and Cement chapters of this volume. The following tables show the total sales of stone by kinds, uses, and States.

Stone sold or used by producers in the United States, 1940-44, by kinds
[Quantities approximate]

Year	Granite		Basalt and related rocks (trap rock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	10,880,580	\$21,621,943	15,715,890	\$15,185,682	239,730	\$5,196,124	112,658,060	\$103,007,305
1941.....	14,298,750	24,968,489	17,936,950	18,641,852	176,460	4,785,710	133,163,600	127,585,118
1942.....	14,064,780	23,794,514	17,626,660	21,005,943	169,500	3,910,203	142,487,600	138,578,027
1943.....	9,240,280	18,217,064	14,385,260	17,699,907	168,790	3,610,035	128,980,270	127,296,872
1944.....	7,395,390	17,200,247	14,043,290	17,158,774	152,710	4,374,722	115,506,130	118,550,317

Year	Sandstone		Other stone ¹		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	6,498,960	\$8,513,654	7,739,820	\$6,519,437	153,733,040	\$160,044,115
1941.....	7,592,820	10,768,748	9,939,390	8,587,509	183,107,960	195,337,426
1942.....	6,700,920	8,620,453	14,835,030	9,092,879	195,884,490	205,002,019
1943.....	7,408,230	11,071,258	11,160,420	6,424,898	171,343,250	184,320,034
1944.....	6,426,670	10,965,211	12,055,390	7,372,886	155,579,580	175,642,157

¹ Includes mica schist, conglomerate, argillite, various light-color volcanic rocks, serpentine not used as marble, soapstone sold as dimension stone, and such other stone as cannot properly be classed in any main group.

Stone sold or used by producers in the United States, 1943-44, by uses

Use	1943		1944	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone:				
Rough construction..... short tons..	228,410	\$961,416	106,900	\$696,988
Cut stone, slabs, and mill blocks cubic feet..	1,182,930	1,845,230	1,224,740	2,072,005
Approximate equivalent in short tons.....	90,210		92,950	
Rubble..... short tons.....	252,770	402,900	135,060	230,620
Monumental stone..... cubic feet.....	2,541,080	9,731,521	2,940,150	11,396,526
Approximate equivalent in short tons.....	209,840		242,750	
Paving blocks..... number.....	651,890	67,333	655,359	45,417
Approximate equivalent in short tons.....	7,030		3,800	
Curbing..... cubic feet.....	147,760	172,223	207,060	194,272
Approximate equivalent in short tons.....	11,640		16,580	
Flagging..... cubic feet.....	415,850	186,732	263,590	218,988
Approximate equivalent in short tons.....	31,820		20,580	
Total dimension stone (quantities approximate, in short tons).....	831,720	13,367,355	618,620	14,854,816
Crushed and broken stone:				
Riprap..... short tons.....	4,950,470	4,834,513	4,011,210	4,947,843
Crushed stone..... do.....	99,648,080	94,744,029	83,080,550	78,701,175
Furnace flux (limestone)..... do.....	31,570,650	24,505,567	31,080,330	25,130,113
Refractory stone ¹ do.....	2,707,800	4,577,047	2,313,640	3,922,238
Agricultural (limestone)..... do.....	14,521,670	19,057,120	18,941,220	25,316,219
Other uses..... do.....	17,112,800	23,234,403	15,534,010	22,769,753
Total crushed and broken stone..... do.....	170,511,530	170,952,679	154,960,960	160,787,341
Grand total (quantities approximate, in short tons).....	171,343,250	184,320,034	155,579,580	175,642,157

¹ Gansler (sandstone), mica schist, soapstone, and dolomite.

Stone sold or used by noncommercial producers in the United States, 1943-44, by uses

[Included in total production]

Use	1943		1944	
	Short tons	Value	Short tons	Value
Building stone.....	32,560	\$45,412	19,610	\$25,362
Rubble.....	24,710	20,590	32,680	49,906
Flagging.....			2,170	7,650
Riprap.....	1,302,900	928,406	740,900	820,531
Crushed stone.....	7,505,770	7,857,022	7,979,540	8,429,328
Agricultural (limestone).....	334,680	365,245	264,770	342,582
Other uses.....	839,310	874,926	442,080	577,877
	10,039,930	10,091,600	9,481,780	10,253,578

Stone sold or used by producers in the United States, 1943-44, by States

State	1943		1944	
	Short tons (approximate)	Value	Short tons (approximate)	Value
Alabama.....	2,568,530	\$3,178,908	2,542,210	\$3,385,801
Alaska.....	(¹)	(¹)	(¹)	(¹)
Arizona.....	340,200	317,454	² 116,670	² 105,662
Arkansas.....	1,492,410	¹ 568,883	730,310	790,271
California.....	8,231,250	¹ 595,799	² 9,909,680	² 9,987,362
Colorado.....	880,430	682,804	680,620	568,096
Connecticut.....	1,184,950	1,392,215	1,029,790	1,213,543
Delaware.....	(¹)	(¹)	9,970	14,968
Florida.....	² 8,741,200	² 7,446,388	2,730,020	2,600,462
Georgia.....	2,178,510	5,373,879	1,773,150	5,037,596
Hawaii.....	(¹)	(¹)	² 1,960,730	² 2,891,304
Idaho.....	91,330	127,092	² 323,000	² 413,805
Illinois.....	11,137,960	10,762,707	10,680,640	10,700,140
Indiana.....	5,381,940	5,570,790	4,102,140	4,562,309
Iowa.....	3,544,560	4,327,782	² 3,563,020	² 4,175,005
Kansas.....	2,074,580	2,291,198	2,121,020	2,069,738
Kentucky.....	4,621,720	4,309,201	3,566,920	3,472,065
Louisiana.....	(¹)	(¹)	1,079,150	894,681
Maine.....	201,450	409,780	² 125,840	² 332,736
Maryland.....	1,423,970	2,029,927	² 1,272,480	² 1,756,318
Massachusetts.....	² 1,370,460	² 2,170,406	1,284,070	2,287,060
Michigan.....	15,919,780	9,669,672	15,789,320	8,709,353
Minnesota.....	² 658,600	² 1,205,910	² 1,316,790	² 2,245,814
Mississippi.....	(¹)	(¹)	(¹)	(¹)
Missouri.....	5,636,040	5,864,005	4,856,540	5,312,384
Montana.....	509,540	365,777	² 232,090	² 229,100
Nebraska.....	538,380	968,932	169,720	483,563
Nevada.....	107,390	165,483	90,590	138,954
New Hampshire.....	70,910	171,371	910	48,000
New Jersey.....	2,611,440	3,584,645	2,211,690	3,321,978
New Mexico.....	² 421,590	² 228,432	² 609,240	² 334,357
New York.....	8,660,970	8,917,164	7,454,160	8,073,778
North Carolina.....	4,871,260	5,376,600	4,659,540	5,975,951
Ohio.....	15,909,740	15,598,542	² 15,048,230	² 15,292,705
Oklahoma.....	6,169,750	3,205,329	4,563,270	1,799,765
Oregon.....	1,535,490	1,834,271	1,947,230	2,378,142
Pennsylvania.....	² 19,999,570	² 23,566,298	² 18,175,280	² 22,516,282
Puerto Rico.....	(¹)	(¹)	² 175,330	² 200,619
Rhode Island.....	171,230	410,478	² 19,790	² 213,351
South Carolina.....	² 1,615,730	² 1,804,196	1,195,900	1,717,296
South Dakota.....	² 269,410	² 1,304,370	255,530	1,412,141
Tennessee.....	8,280,320	10,047,944	² 6,063,420	² 7,776,775
Texas.....	2,698,220	2,534,271	² 2,742,120	² 2,455,791
Utah.....	390,480	416,821	² 363,880	² 363,285
Vermont.....	154,170	3,779,673	168,500	4,396,576
Virginia.....	5,668,090	6,615,944	5,539,760	6,360,789
Washington.....	2,081,810	2,499,580	² 2,538,690	² 2,756,332
West Virginia.....	² 3,157,190	² 3,324,912	3,455,450	3,718,735
Wisconsin.....	² 4,186,140	² 6,677,382	4,658,620	² 7,741,499
Wyoming.....	259,360	197,641	396,660	383,463
Undistributed.....	3,325,210	5,449,205	1,279,840	2,006,349
	171,343,250	184,320,034	155,579,580	175,642,157

¹ Included under "Undistributed."² To avoid disclosing confidential information, certain State totals are incomplete, the figures not included being combined under "Undistributed."

DIMENSION STONE

Dimension stone and crushed stone are so diverse in character and use that they are considered in separate sections of this chapter. The term "dimension stone" is applied to blocks or slabs of natural stone, most of which are cut to definite shapes and sizes. The principal uses of dimension stone are for construction of masonry walls and for memorials. Crushed and broken stone, on the other hand, consists of irregular fragments or grains, sized chiefly by mechanical screening or air separation. The principal uses are as roadstone, concrete aggregate, railroad ballast, furnace flux, and a great variety of industrial applications that have little or no relation to masonry construction.

Dimension-stone producers may be divided into three main groups upon the basis of plant operation. The first group quarries stone and sells it as rough blocks or slabs; the second quarries stone and also manufactures it into finished products; and the third buys sawed slabs or rough blocks of stone and manufactures them into finished products but does not operate quarries. The Bureau of Mines statistical canvass covers the first and second but not the third group. Bureau of Mines statistics are compiled from reports of quantities and values of original sales; hence they include some material sold as rough blocks and some sold as finished products.

Total sales of dimension stone in 1944 declined 25 percent in quantity but increased 8 percent in value compared with 1943. These over-all figures include slate, but details of this branch of the industry are given in the separate chapter on Slate.

The following table presents salient statistics for 1943 and 1944:

Dimension stone sold or used by producers in the United States, 1943-44, by kinds and uses

Kind and use	1943	1944	
		Total	Percent of change
Granite:			
Building stone:			
Rough construction..... short tons..	19, 100	8, 790	-54
Value.....	\$38, 053	\$36, 636	-4
Average per ton.....	\$1. 99	\$4. 17	+110
Cut stone, slabs, and mill blocks..... cubic feet..	103, 830	104, 650	+1
Value.....	\$212, 557	\$235, 228	+11
Average per cubic foot.....	\$2. 05	\$2. 25	+10
Rubble..... short tons..	65, 850	44, 000	-33
Value.....	\$120, 296	\$88, 994	-26
Monumental stone..... cubic feet..	2, 167, 760	2, 507, 780	+16
Value.....	\$7, 474, 882	\$8, 594, 682	+15
Average per cubic foot.....	\$3. 45	\$3. 43	-1
Paving blocks..... number..	637, 370	649, 359	+2
Value.....	\$66, 542	\$45, 017	-32
Curbing..... cubic feet..	64, 780	153, 060	+136
Value.....	\$79, 124	\$128, 283	+62
Total:			
Quantity..... approximate short tons..	283, 880	283, 780	-----
Value.....	\$7, 991, 454	\$9, 128, 840	+14
Basalt and related rocks (trap rock):			
Building stone:			
Rough construction..... short tons..	101, 330	5, 320	-95
Value.....	\$105, 689	\$12, 183	-88
Average per ton.....	\$1. 04	\$2. 29	+120
Rubble..... short tons..	24, 000	13, 140	-45
Value.....	\$13, 104	\$4, 991	-62
Total:			
Quantity..... short tons..	125, 330	18, 460	-85
Value.....	\$118, 773	\$17, 174	-86

Dimension stone sold or used by producers in the United States, 1943-44, by kinds and uses—Continued

Kind and use	1943	1944	
		Total	Percent of change
Marble:			
Building stone (cut stone, slabs, and mill blocks)..... cubic feet..	137, 800	178, 170	+29
Value.....	\$322, 853	\$1, 065, 638	+30
Average per cubic foot.....	\$5. 97	\$5. 98	.....
Monumental stone..... cubic feet..	373, 320	432, 370	+16
Value.....	\$2, 256, 639	\$2, 801, 844	+24
Average per cubic foot.....	\$6. 04	\$6. 48	+7
Total:			
Quantity..... approximate short tons..	43, 390	51, 900	+20
Value.....	\$3, 079, 492	\$3, 867, 482	+26
Limestone:			
Building stone:			
Rough construction..... short tons..	52, 680	47, 360	-10
Value.....	\$76, 468	\$58, 076	-24
Average per ton.....	\$1. 45	\$1. 23	-15
Cut stone, slabs, and mill blocks..... cubic feet..	719, 610	730, 570	+2
Value.....	\$497, 752	\$481, 631	-3
Average per cubic foot.....	\$0. 69	\$0. 66	-4
Rubble..... short tons..	124, 420	54, 200	-56
Value.....	\$198, 112	\$60, 833	-69
Flagging..... cubic feet..	76, 960	76, 250	-1
Value.....	\$25, 516	\$22, 789	-11
Total:			
Quantity..... approximate short tons..	237, 080	161, 640	-32
Value.....	\$797, 848	\$623, 329	-22
Sandstone:			
Building stone:			
Rough construction..... short tons..	24, 380	22, 440	-8
Value.....	\$50, 976	\$51, 674	+2
Average per ton.....	\$2. 09	\$2. 31	+11
Cut stone, slabs, and mill blocks..... cubic feet..	221, 690	211, 390	-5
Value.....	\$312, 068	\$289, 508	-7
Average per cubic foot.....	\$1. 41	\$1. 37	-3
Rubble..... short tons..	29, 870	18, 970	-36
Value.....	\$56, 672	\$62, 750	+11
Paving blocks..... number..	14, 520	6, 000	-59
Value.....	\$791	\$400	-49
Curbing..... cubic feet..	82, 980	54, 000	-35
Value.....	\$93, 099	\$65, 989	-29
Flagging..... cubic feet..	325, 420	175, 500	-46
Value.....	\$153, 869	\$189, 799	+23
Total:			
Quantity..... approximate short tons..	101, 380	74, 160	-27
Value.....	\$667, 475	\$659, 320	-1
Miscellaneous stone:¹			
Building stone..... cubic feet..	370, 060	273, 070	-26
Value.....	\$690, 250	\$538, 219	-22
Average per cubic foot.....	\$1. 87	\$1. 97	+5
Rubble..... short tons..	8, 630	4, 750	-45
Value.....	\$14, 716	\$13, 052	-11
Flagging..... cubic feet..	13, 470	11, 840	-12
Value.....	\$7, 347	\$7, 400	+1
Total:			
Quantity..... approximate short tons..	40, 660	28, 680	-29
Value.....	\$712, 313	\$558, 671	-22
Total dimension stone, excluding slate:			
Quantity..... approximate short tons..	831, 720	618, 620	-26
Value.....	\$13, 367, 355	\$14, 854, 816	+11
Slate as dimension stone:²			
Quantity..... approximate short tons..	73, 310	60, 950	-17
Value.....	\$1, 946, 349	\$1, 720, 958	-12
Total dimension stone, including slate:			
Quantity..... approximate short tons..	905, 030	679, 570	-25
Value.....	\$15, 313, 704	\$16, 575, 774	+8

¹ Includes soapstone, mica schist, volcanic rocks, argillite, and other varieties that cannot be classified in the principal groups.

² Details of production, by uses, are given in the chapter on Slate in this volume.

BUILDING STONE

The use of stone as a material of construction antedates the most ancient historic records. It has always occupied an important place in the construction of monumental buildings, but it has found very limited use under wartime conditions. Sales in 1944 dropped even lower than the all-time low of 1943. The following table gives the quantity and value of each kind of building stone sold in 1944.

Building stone sold or used by producers in the United States in 1944, by kinds

Kind	Rough			
	Construction		Architectural	
	Cubic feet	Value	Cubic feet	Value
Granite.....	106,550	\$36,636	45,510	\$42,916
Basalt.....	62,540	12,183		
Marble.....			57,750	103,088
Limestone.....	578,630	58,076	426,640	168,855
Sandstone.....	284,180	51,874	23,040	11,360
Miscellaneous.....	273,070	538,219		
	1,304,870	696,988	552,940	326,219

Kind	Finished				Total	
	Sawed ¹		Cut ¹			
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
Granite.....	24,790	\$77,208	34,350	\$115,104	211,200	\$271,864
Basalt.....					62,540	12,183
Marble.....	29,320	97,528	91,100	865,022	178,170	1,065,638
Limestone.....	230,930	152,638	73,000	160,138	1,309,100	539,707
Sandstone.....	159,400	187,944	28,950	90,204	495,570	341,382
Miscellaneous.....					273,070	538,219
	444,440	515,318	227,400	1,230,468	2,529,650	2,768,993

¹ For granite, sawed stone corresponds to dressed stone for construction work (walls, foundations, bridges) and cut stone to architectural stone for high-class buildings.

GRANITE

Sales of granite in the form of blocks or slabs remained virtually unchanged in quantity but gained 14 percent in value in 1944 compared with 1943. The relatively high value was due primarily to larger sales of cut and dressed stone, and smaller sales of the lower-priced rough construction stone and rubble. Sales of rough construction stone were less than half as large and rubble two-thirds as large as in 1943. Architectural stone declined slightly, but memorial stone production made substantial gains. Sales of rough monumental stone increased 16 percent in both quantity and value and dressed monumental stone registered an advance of 15 percent in quantity and 14 percent in value. The number of paving blocks sold gained slightly. A large proportion of the 1944 output consisted of the small dux blocks. Curbing production was nearly two and one-half times as great as in 1943.

The average selling price of dressed building stone was 30 cents a cubic foot higher in 1944 than in 1943, whereas prices of rough and dressed memorial stone declined 1 and 5 cents, respectively, per cubic foot.

Granite (dimension stone) sold or used by producers in the United States in 1944, by States and uses

State	Active plants	Building						Monumental				Paving blocks		Curbing		Total		
		Rough			Dressed			Rubble		Rough		Dressed		Num-ber	Value		Cubic feet	Value
		Construction		Cubic feet	Architectural		Cubic feet	Value	Short tons	Value	Cubic feet	Value						
		Short tons	Value		Cubic feet	Value												
California.....	14	40	\$142	1,560	\$3,120	1,910	\$9,400	760	\$4,967	21,620	\$63,550	23,500	\$203,670			4,780	\$284,849	
Colorado.....	6									2,030	4,914	3,144				1,270	8,094	
Connecticut.....	3																	
Georgia.....	15																	
Idaho.....	1	140	678	22,070	15,821	4,210	10,644	3,210	3,321	504,540	659,165	165,320	814,196	5,000	\$400	60,310	1,496,276	
Illinois.....	5	3,790	14,612	6,100	3,000			1,600	3,434	10,570	9,909	6,080	37,378			53,250	81,200	
Iowa.....	3															15,860	87,675	
Maryland.....	3															15,860	357,804	
Massachusetts.....	15															23,920	672,357	
Minnesota.....	2																	
Missouri.....	4																	
Montana.....	3																	
New Hampshire.....	3																	
New York.....	2																	
North Carolina.....	8	400	2,000						4,225									
Oklahoma.....	7																	
Oregon.....	1																	
Pennsylvania.....	1	910	2,280							1,000	3,000							
Rhode Island.....	2																	
South Carolina.....	2									65,030	194,607							
South Dakota.....	6									62,600	92,901	108,640	961,302			6,990	163,900	
Texas.....	4									738,500	2,561,181	3,570	42,780			5,300	194,607	
Vermont.....	6									7,400	15,640							
Virginia.....	3															14,220	1,069,252	
Washington.....	3															1,430	74,821	
Wisconsin.....	12															59,820	2,561,181	
Undistributed.....		3,510	17,024	2,700	3,007	53,020	172,268	36,430	72,811	359,730	857,860	64,220	472,669			2,680	16,603	
																2,680	16,603	
																23,020	923,970	
																23,020	568,129	

* Included under "Undistributed."

† 100,550 cubic feet (approximate).

The following tables show sales of monumental granite in the Barre district, Vermont.

Monumental granite sold by quarrymen in the Barre district, Vermont, 1940-44¹

Year	Cubic feet	Value	Year	Cubic feet	Value
1940.....	601, 190	\$2, 039, 960	1943.....	635, 350	\$2, 267, 777
1941.....	764, 280	2, 431, 152	1944.....	733, 500	2, 553, 681
1942.....	612, 220	2, 035, 327			

¹ Barre granite is sold also for construction and crushed stone.

Estimated output of monumental granite in the Barre district, Vermont, 1942-44¹

	1942	1943	1944
Total quarry output, rough stock..... cubic feet.....	750, 000	578, 148	613, 306
Shipped out of Barre district in rough..... do.....	150, 000	115, 630	122, 661
Manufactured in Barre district..... do.....	600, 000	462, 518	490, 647
Light stock consumed in district..... do.....	468, 750	289, 074	383, 319
Dark stock consumed in district..... do.....	281, 250	173, 444	229, 989
Number of cutters in district..... do.....	1, 295	1, 204	1, 200
Average daily wage.....	\$9. 50	\$9. 50	\$10. 00
Average number of days worked.....	230	222	244
Total pay roll for year.....	\$2, 829, 575	\$2, 539, 236	\$2, 928, 000
Estimated overhead.....	1, 414, 787	1, 269, 618	1, 464, 000
Estimated value of light stock.....	1, 640, 625	1, 318, 900	1, 494, 934
Estimated value of dark stock.....	1, 265, 625	1, 008, 146	1, 069, 449
Estimated polishing cost.....	474, 525	365, 794	129, 347
Output from saws.....	158, 175	121, 931	388, 038
Total value of granite.....	7, 783, 312	6, 623, 625	7, 473, 768

¹ Through the kindness of the Granite Manufacturers' Association, Barre, figures covering the entire granite industry of the Barre district are given in this table to supplement figures of sales reported by quarrymen.

BASALT AND RELATED ROCKS (TRAP ROCK)

Basalt and related rocks are not used extensively as building stone. The industry experienced the most serious decline in its history in 1944. Total sales were only 15 percent in quantity and 14 percent in value of those recorded in 1943. Basalt and related rocks are used to some extent for memorials, but such stones are classed in trade as black granite and are therefore included with the figures for monumental granite.

Basalt and related rocks (trap rock) (dimension stone) sold or used by producers in the United States in 1944, by States and uses

State	Active plants	Building stone				Total	
		Rough construction		Rubble		Short tons	Value
		Short tons	Value	Short tons	Value		
Connecticut.....	1	(1)	(1)			(1)	(1)
Hawaii.....	1	(1)	(1)	(1)	(1)	(1)	(1)
Montana.....	1			(1)	(1)	(1)	(1)
New Jersey.....	2	(1)	(1)	(1)	(1)	190	\$197
Oregon.....	2	(1)	(1)	(1)	(1)	1, 690	6, 894
Pennsylvania.....	1	3, 330	\$4, 186			3, 330	4, 186
Undistributed.....		1, 990	7, 997	13, 140	\$4, 991	13, 250	5, 897
Average unit value.....	8	\$ 5, 320	12, 183	13, 140	4, 991	18, 460	17, 174
			\$2. 29		\$0. 38		\$0. 93

¹ Included under "Undistributed."

² 62,540 cubic feet (approximate).

MARBLE

Although marble sales gained in every category in 1944 compared with 1943, they were still below those of 1935 at the lowest level of the depression period. The value of sales in 1944 was, however, higher than in either 1934 or 1935. The increase in 1944 over 1943 amounted to 20 percent in quantity and 26 percent in value. Building marble registered the largest gains—29 percent in quantity and 30 percent in value. Sales of monumental stone increased 16 percent in quantity and 24 percent in value. The average value per cubic foot of building marble increased less than 1 percent and of monumental marble 7 percent. Although the quantity of building marble sold was only a fraction of that used in the predepression era, the substantial gain is a hopeful sign. When the erection of large public buildings is again a widespread activity, marble may regain its rightful place as an important material of construction.

Marble (dimension stone) sold by producers in the United States, 1943-44, by uses

Use	1943		1944	
	Cubic feet	Value	Cubic feet	Value
Building stone:				
Rough:				
Exterior.....	14,850	\$25,152	17,460	\$27,485
Interior ¹	26,280	45,584	40,290	75,603
Finished:				
Exterior.....	6,620	13,953	8,580	78,082
Interior.....	90,050	738,164	111,840	884,468
Total exterior.....	21,470	39,105	26,040	105,567
Total interior.....	116,330	783,748	152,130	960,071
Total building stone.....	137,800	822,853	178,170	1,065,638
Monumental stone:				
Rough.....	373,320	2,256,639	30,000	30,000
Finished.....			402,370	2,771,844
Total monumental stone.....	373,320	2,256,639	432,370	2,801,844
Total building and monumental.....	511,120	3,079,492	610,540	3,867,482
Approximate short tons.....	43,390		51,900	

¹ Includes onyx for the manufacture of mantels, lamp bases, desk sets, clock cases, and novelties.

Marble (dimension stone) sold by producers in the United States in 1944, by States and uses

State	Active plants	Building		Monumental		Total		
		Cubic feet	Value	Cubic feet	Value	Quantity		Value
						Cubic feet	Short tons (approximate)	
Alabama.....	2	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Arkansas.....	1	1,600	\$1,920	300	\$360	1,900	160	\$2,280
Georgia.....	1	7,230	69,917	211,790	1,333,277	219,020	18,620	1,403,194
Maryland.....	1	310	3,512	-----	-----	310	30	3,512
Minnesota.....	1	(¹)	(¹)	-----	-----	(¹)	(¹)	(¹)
Missouri.....	2	9,550	79,189	14,680	58,632	24,230	2,060	137,821
North Carolina.....	1	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Tennessee.....	6	82,600	499,892	31,730	319,040	114,330	9,720	818,932
Utah ²	1	8,710	14,000	-----	-----	8,710	740	14,000
Vermont.....	2	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Undistributed.....	-----	68,170	397,208	173,870	1,090,535	242,040	20,570	1,487,743
	18	178,170	1,065,638	432,370	2,801,844	610,540	51,900	3,867,482
Average unit value.....	-----	-----	\$5.98	-----	\$6.48	-----	-----	³ \$6.33
Short tons (approximate).....	-----	15,150	-----	36,750	-----	-----	-----	-----

¹ Included under "Undistributed."

² Figures represent only rough blocks for the manufacture of mantels, lamp bases, desk sets, clock cases, and novelties.

³ Average value per cubic foot.

LIMESTONE

Limestone blocks cut to definite shapes and sizes are used almost exclusively for building purposes. Under normal conditions limestone is used extensively, particularly for interiors and exteriors of public buildings of all kinds, such as post offices, museums, churches, schools, and court houses, as well as commercial buildings. The erection of such buildings virtually ceased when the industry and manpower of the Nation became focused on the all-important problem of winning the war. Accordingly, the building limestone industry was greatly restricted in 1944. The Indiana Limestone Co., normally the largest producing unit in the industry, produced no stone in 1944; it devoted its equipment and personnel to manufacturing activities directly connected with the war. Other limestone companies likewise devoted their skill and facilities, at least in part, to war work.

Total sales in 1944 were 32 percent less in quantity and 22 percent less in value than in 1943. The principal decline in 1944 was in the crudest form of building stone, classed as rubble; sales fell to less than one-half of those recorded in 1943. Rough construction stone sales were a little lower than in 1943, but both rough architectural and finished (cut and sawed) stone increased slightly. Although the gains are small, they at least convey the inference that the worst is over and that an upward movement is at last under way in the use of high-grade building stone. An upward trend certainly would be welcomed because the value of sales of building stone (excluding rubble) in 1944 (\$539,707) was less than 3 percent of the value in 1929 (\$20,649,257).

The most productive area in the United States is centered in the vicinity of Bedford and Bloomington, Ind. This area supplied 81 percent of the rough architectural and finished (sawed and cut) limestone sold in 1944.

Limestone (dimension stone) sold or used by producers in the United States in 1944, by States and uses

State	Active plants	Building						Flagging		Total	
		Rough		Finished (cut and sawed)		Rubble		Cubic feet	Value	Short tons (approximate)	Value
		Construction	Architectural	Cubic feet	Value	Short tons	Value				
California.....	3	(1)		710	\$1,237	(1)	(1)			430	\$529
Colorado.....	1									60	1,237
Illinois.....	8	(1)		339,060	133,829	4,530	\$4,985	(1)	(1)	5,120	7,451
Indiana.....	13	(1)				(1)	(1)	(1)	(1)	50,680	360,878
Iowa.....	1									(1)	(1)
Kansas.....	12	4,190	\$5,333	500	175	2,180	3,150	27,250	\$7,950	9,740	31,608
Kentucky.....	4	(1)				(1)	(1)			1,380	1,340
Maryland.....	1									(1)	(1)
Michigan.....	1	(1)								(1)	(1)
Minnesota.....	7	3,000	9,000	6,810	6,441	1,020	2,375	(1)	(1)	5,540	26,616
Missouri.....	6	(1)				3,300	7,374	(1)	(1)	4,370	29,433
New York.....	2					(1)	150	(1)	(1)	(1)	333
Ohio.....	3	(1)								480	(1)
Oklahoma.....	1	(1)								(1)	10,120
Pennsylvania.....	11	(1)				5,420	6,922	(1)	(1)	33,000	28,008
Puerto Rico.....	5	(1)								(1)	(1)
South Dakota.....	2	(1)								(1)	(1)
Tennessee.....	3	(1)								5,900	9,129
Texas.....	3									2,350	54,423
Vermont.....	1									(1)	(1)
Virginia.....	2	(1)								(1)	(1)
West Virginia.....	1									(1)	(1)
Wisconsin.....	19	23,340	22,986	(1)	(1)	3,650	7,371	17,050	6,614	26,920	50,461
Wyoming.....	2	16,830	20,757	79,030	27,173	33,250	28,506	31,950	8,225	5,310	11,743
Undistributed.....											
Average unit value.....	112	47,360	98,076	426,940	168,855	54,200	60,833	76,260	22,789	161,940	923,329
Short tons (approximate).....		(1)	\$1.23	31,020	\$0.40	\$1.03	\$1.12	6,280	\$0.30		\$3.86

* Included under "Undistributed."
 † 578,530 cubic feet (approximate).

The following tables show production for the Bedford-Bloomington, Ind., and the Carthage, Mo., areas over a 5-year period.

Limestone sold by producers in the Indiana oolitic limestone district, 1940-44, by classes

Year	Construction					
	Rough block		Sawed and semi-finished		Cut	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1940.....	1,395,910	\$425,990	994,370	\$573,368	831,900	\$1,125,825
1941.....	1,047,000	309,444	1,029,970	567,706	826,510	1,177,651
1942.....	526,620	160,117	135,360	98,519	766,320	1,070,164
1943.....	288,750	94,500	135,580	92,034	141,200	211,019
1944.....	339,090	133,829	1254,060	1222,354	(1)	(1)

Year	Construction—Continued			Other uses		Total	
	Total						
	Cubic feet	Short tons (approximate)	Value	Short tons	Value	Short tons (approximate)	Value
1940.....	3,222,180	233,600	\$2,125,183	79,730	\$40,676	313,330	\$2,165,859
1941.....	2,903,480	210,500	2,054,801	135,610	98,547	346,110	2,153,348
1942.....	1,428,300	103,500	1,328,800	87,770	69,404	191,270	1,398,204
1943.....	565,530	41,000	397,553	150,710	181,303	191,710	578,856
1944.....	593,150	43,000	356,183	16,380	13,690	59,380	369,873

¹ Cut stone is included under sawed and semi-finished stone.

Indiana limestone sold by mills in the district not operated by quarry companies and by mills of quarry companies from stock obtained at quarries other than their own, 1940-44, by classes

Year	Sawed and semi-finished		Cut		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1940.....	272,510	\$182,239	1,034,100	\$1,629,273	1,306,610	\$1,811,512
1941.....	86,690	47,502	690,250	1,043,774	776,940	1,091,276
1942.....	154,680	117,128	1449,950	1746,312	504,630	763,440
1943.....	(1)	(1)	1232,700	1362,757	232,700	362,757
1944.....	(1)	(1)	1287,130	1529,391	287,130	529,391

¹ A small amount of sawed and semifinished stone included under cut stone.

² No stone sold from mills of quarry companies from stock obtained at quarries other than their own.

Limestone and marble sold by producers in the Carthage district, Jasper County, Mo., 1940-44, by classes

Year	Dimension stone (rough and dressed)						Other uses		Total		
	Building		Monumental		Total		Short tons	Value	Short tons (ap- proximate)	Value	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Short tons (ap- proximate)					Value
1940.....	124, 180	\$248, 498	8, 430	\$18, 844	132, 610	11, 070	\$267, 342	90, 390	\$128, 627	101, 460	\$395, 969
1941.....	50, 000	219, 361	8, 680	19, 868	58, 680	4, 900	239, 229	253, 030	414, 770	267, 930	653, 999
1942.....	22, 580	100, 581	9, 590	23, 271	32, 170	2, 650	123, 852	436, 600	538, 697	439, 250	662, 549
1943.....	11, 950	66, 326	10, 910	33, 532	22, 860	1, 910	96, 858	299, 730	487, 519	301, 640	587, 377
1944.....	14, 180	94, 338	14, 680	58, 632	28, 860	2, 420	152, 970	218, 190	476, 750	220, 610	629, 720

SANDSTONE

Sandstone in the form of dimension stone is used chiefly as building stone. The harder varieties are used for paving stones, but this branch of the industry has declined to an almost insignificant figure during the past 15 years. The manufacture of curbing and flagging has also declined but less drastically than paving-stone manufacture. Sandstone is used for making grindstones, pulpstones, and whetstones, but statistics on these commodities are included in the chapter on Abrasive Materials.

Sales of dimension sandstone declined 27 percent in quantity but only 1 percent in value in 1944 compared with 1943. Declines were registered in every category except sawed building stone, which gained 12 percent in quantity. Unit values were considerably higher for rough construction stone, cut building stone, rubble, curbing, and flagging. Prices were lower for rough architectural stone and sawed building stone.

Ohio is the principal producer. Its quarries furnished 60 percent of the total value of output in 1944. Other producing States, in order of sales value, were New York, Pennsylvania, Tennessee, and West Virginia.

The second table following presents a 22-year history of the bluestone industry. Bluestone is a type of sandstone that splits readily into thin, uniform sheets. It is particularly well-adapted for flagging but is used also for building stone and curbing. Although sales in 1944 were 56 percent greater than in 1943, they were only 25 percent of those in 1923.

Sandstone (dimension stone) sold or used by producers in the United States in 1944, by States and uses

State	Active plants	Building						Rubble		Paving blocks		Curbing		Flagging		Total	
		Rough construction		Rough architectural		Sawed		Short tons	Value	Number	Value	Cubic feet	Value	Cubic feet	Value	Short tons (approximate)	Value
		Short tons	Value	Cubic feet	Value	Cubic feet	Value										
California	3	(1)	(1)					(1)	(1)					(1)	(1)	6,460	\$19,387
Colorado	2	(1)	(1)					(1)	(1)					(1)	(1)	(1)	(1)
Georgia	1															(1)	(1)
Idaho	1															240	6,757
Michigan	8	2,790	\$5,438													8,650	\$2,429
New York	4	2,270	1,588	(1)	(1)	159,400	\$187,944	26,490	\$3,447	6,000	\$400	11,730	\$13,783	62,700	\$92,898	22,830	\$97,701
Ohio	4	3,040	1,708					(1)	(1)			(1)	(1)	60,720	61,063	807,701	
Pennsylvania	12							(1)	(1)			(1)	(1)	31,890	29,219	11,830	68,419
Tennessee	3	(1)	(1)					(1)	(1)			(1)	(1)			7,900	43,732
Virginia	3	(1)	(1)					(1)	(1)			(1)	(1)			1,230	1,083
West Virginia	5	(1)	(1)					(1)	(1)							12,780	30,545
Undistributed		16,340	37,050	23,040	\$11,360			18,970	\$62,750			42,270	\$2,206	20,190	34,811	3,100	8,267
Average unit value	42	22,440	51,874	23,040	\$0.49	159,400	\$187,944	28,050	\$0.294	6,000	\$0.07	54,000	\$5,969	175,500	\$1.08	74,160	\$59,320
Short tons (approximate)		(1)	\$2.31	1,680		11,540	\$1.18		\$3.31			3,960	\$1.22				\$5.89

1 Included under "Undistributed."

2 Includes 105,430 cubic feet of bluestone (approximately 8,220 short tons) valued at \$78,969 sold for construction, curbing, and flagging.

3 Includes 50,730 cubic feet of bluestone (approximately 4,000 short tons) valued at \$31,743 sold for construction and flagging.

4 284,180 cubic feet (approximate).

Bluestone (dimension stone) sold or used in the United States, 1923-44¹

Year	Cubic feet	Value	Year	Cubic feet	Value
1923.....	618, 360	\$747, 422	1934.....	181, 960	\$168, 720
1924.....	769, 240	875, 734	1935.....	215, 150	203, 537
1925.....	987, 300	910, 585	1936.....	343, 040	332, 749
1926.....	692, 640	885, 597	1937.....	308, 740	346, 349
1927.....	815, 730	1, 000, 217	1938.....	329, 670	359, 857
1928.....	891, 190	1, 014, 843	1939.....	254, 440	319, 405
1929.....	670, 020	773, 532	1940.....	255, 900	272, 501
1930.....	611, 240	749, 703	1941.....	284, 190	262, 313
1931.....	354, 210	427, 801	1942.....	183, 470	166, 787
1932.....	185, 900	185, 643	1943.....	99, 840	92, 059
1933.....	116, 246	123, 867	1944.....	156, 160	108, 732

¹ New York and Pennsylvania are the only States that produce bluestone.**MISCELLANEOUS STONE**

Types of stone other than those included in the major groups already discussed are covered in the following table. The principal varieties are mica schist, argillite, light-color volcanic rocks, soap-stone, and greenstone. The quantity sold in 1944 decreased 29 percent and the value 22 percent, compared with 1943.

Miscellaneous varieties of stone (dimension stone) sold or used by producers in the United States in 1944, by States and uses

State	Active plants	Building				Flagging		Total	
		Rough and dressed		Rubble		Short tons	Value	Short tons	Value
		Short tons	Value	Short tons	Value				
Georgia.....	1					(¹)	(¹)	(¹)	(¹)
Maryland.....	4	3, 540	\$11, 910	2, 710	\$10, 920	170	\$1, 411	6, 420	\$24, 241
Pennsylvania.....	4	9, 30 ²	17, 909					9, 300	17, 909
Puerto Rico.....	1	(¹)	(¹)	(¹)	(¹)			(¹)	(¹)
Texas.....	1	(¹)	(¹)	(¹)	(¹)			(¹)	(¹)
Virginia.....	2	(¹)	(¹)	(¹)	(¹)			(¹)	(¹)
West Virginia.....	1			(¹)	(¹)			(¹)	(¹)
Undistributed.....		10, 150	508, 400	2, 040	2, 132	770	5, 989	12, 960	516, 521
	14	² 22, 990	538, 219	4, 750	13, 052	² 940	7, 400	28, 680	558, 671
Average unit value.....			\$23. 41		\$2. 75		\$7. 87		\$19. 48

¹ Included under "Undistributed."² Building stone (rough and dressed), approximately 273,070 cubic feet; flagging, approximately 11,840 cubic feet.**TRENDS IN USE OF DIMENSION STONE**

The history of production of dimension stone by kinds, for a 29-year period is indicated in figure 1. A healthy peacetime prosperity is most conducive to activity in the building stone industry. Building stone finds little use in war, a fact well illustrated by the low sales figures for 1918 and 1944 shown in figure 1. The trough of 1931 to 1936 indicates furthermore that industrial depressions react strongly to the detriment of the industry. The promising movement toward recovery in 1939 was cut short by the war in Europe, the unhappy postlude of which precipitated these industries to the lowest depths of adversity in their history.

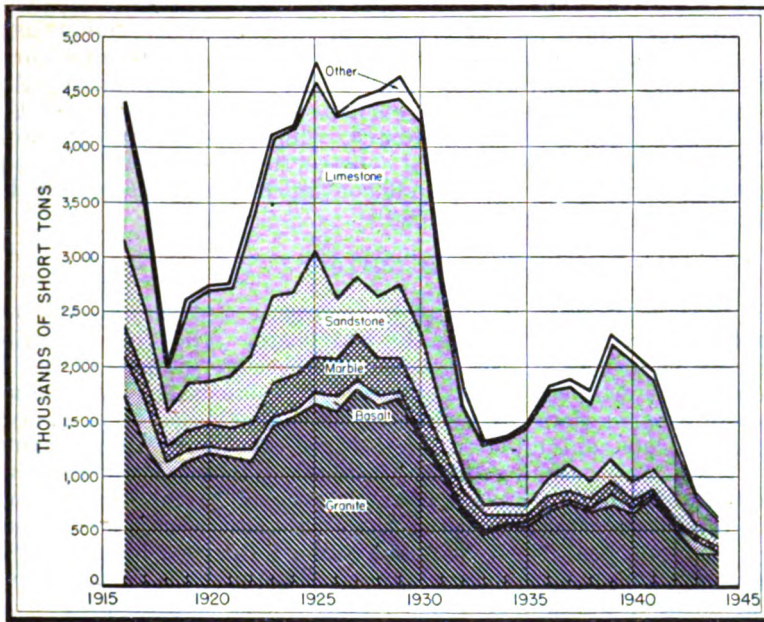


FIGURE 1.—Sales of dimension stone in the United States, by kinds, 1916-44.

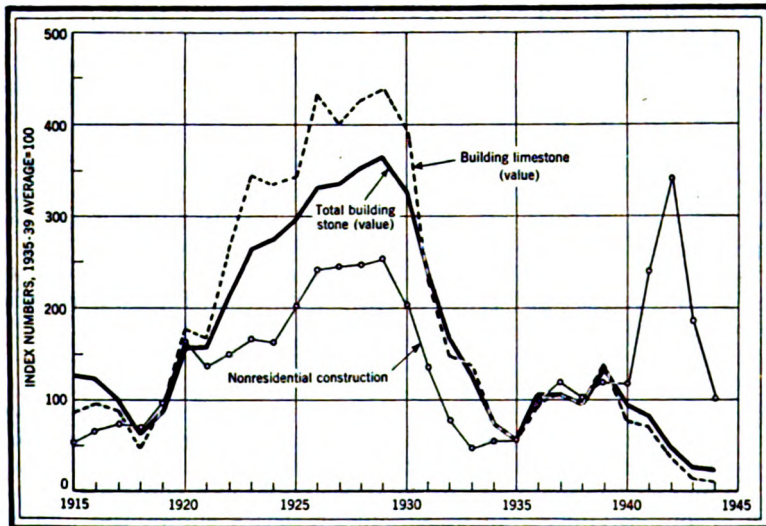


FIGURE 2.—Sales of all building stone and building limestone compared with nonresidential construction (public and private), 1915-44. Data on nonresidential building construction from Bureau of Foreign and Domestic Commerce.

Figure 2 traces for a 30-year period the history of production of all building stones and of the principal variety—limestone—in their relation to nonresidential building, the class of construction using stone most extensively. Activity in building stone production in peacetime follows generally the trend of nonresidential construction, but wartime construction that reached a peak in 1942 failed to stimulate the building stone industry, which has declined steadily since 1939. In 1944 nonresidential construction continued its precipitous decline of 1943. Building stone continued to decline and reached the lowest point in its recorded history.

FUTURE OUTLOOK

The dimension-stone industries have experienced the most serious set-back in their history during the war years. Now that hostilities in Europe have ceased, the prospect for recovery appears on the horizon. That prospect can be measured to some extent by estimates of postwar construction. According to the F. W. Dodge Corp., postwar building projects contemplated for the area east of the Rocky Mountains have a total value of nearly 15 billion dollars. Projects valued at more than 7 billion dollars have progressed to the design stage. As this total is measurably greater than the value of contracted work in any previous peacetime year, the stone industries may view the future with some measure of confidence. The quantity of stone to be used in postwar building will depend upon how large a part of the planned construction will consist of public and commercial building of types that normally employ stone as a major building material. It will depend too upon the extent to which brick, terra cotta, and architectural concrete or other alternative products may be used, and trends in the use of such products cannot be forecast at this time. Very few churches, college buildings, museums, post offices, or other large structures in which stone is used have been built during recent years, and the accumulated need bears promise of growing markets with the advent of a peacetime environment under which the building stone industries thrive.

Memorial stone production, which is an important branch of the granite and marble industries, has been maintained at relatively high levels. The sale of memorials is governed largely by buying power and population and therefore is influenced indirectly only by industrial or building activity. Stone producers have the prospect of enlarged sales for several years to supply material for numerous war memorials.

CRUSHED AND BROKEN STONE

Nearly 155 million short tons of crushed and broken stone were sold in 1944, exclusive of that used for making cement and lime. Sales decreased 9 percent in quantity and 6 percent in value compared with 1943. The average value at the quarry increased 4 cents a ton.

The accompanying table of salient statistics shows the quantity sold and the value of sales during 1943 and 1944, by uses. Detailed data on asphaltic stone and slate granules and flour are given in the chapters on Asphalt and Slate.

Crushed and broken stone sold or used by producers in the United States, 1943-44, by principal uses

Use	1943			1944		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Concrete and road metal	82,412,380	\$83,397,757	\$1.01	64,795,490	\$66,144,499	\$1.02
Railroad ballast	17,235,700	11,346,272	.66	18,285,060	12,556,676	.69
Metallurgical	31,570,650	24,505,567	.78	31,080,330	25,130,113	.81
Alkali works	6,867,190	4,189,940	.61	6,990,370	4,279,141	.61
Riprap	4,950,470	4,834,513	.98	4,011,210	4,947,843	1.23
Agricultural	14,521,670	19,057,120	1.31	18,941,220	25,316,219	1.34
Refractory (ganister, mica schist, dolomite, soapstone)	2,707,860	4,577,047	1.69	2,313,640	3,922,238	1.70
Asphalt filler	440,510	887,908	2.02	449,560	855,480	1.90
Calcium carbide works	526,920	538,425	1.02	509,860	476,292	.93
Sugar factories	347,320	658,209	1.90	254,410	431,462	1.70
Glass factories	504,930	811,991	1.61	512,710	820,150	1.60
Paper mills	384,960	699,266	1.82	375,490	630,425	1.68
Other uses	8,040,970	15,448,664	1.92	6,441,610	15,276,803	2.37
Portland cement (including "cement rock") ¹	170,511,530	170,952,679	1.00	154,960,960	160,787,341	1.04
Natural cement ("cement rock") ¹	35,867,000	(²)	-----	24,148,000	(²)	-----
Lime ³	13,193,000	(²)	-----	12,947,000	(²)	-----
Total stone	219,572,000	(²)	-----	192,056,000	(²)	-----
Asphaltic stone	835,648	3,006,753	3.71	740,454	2,771,925	3.74
Slate granules and flour	395,550	2,923,888	7.39	416,800	3,283,237	7.88

¹ Value reported as cement in chapter on Cement.

² No value available for stone used in manufacture of cement and lime.

³ Value reported as lime in chapter on Lime.

The following tables show the tonnage and value of stone used for concrete aggregate, road construction, and railroad ballast for a series of years and by States for 1944.

Concrete and road metal and railroad ballast sold or used by producers in the United States, 1940-44

Year	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1940	92,814,090	\$86,331,273	7,454,300	\$5,231,815	100,268,390	\$91,563,088
1941	110,192,610	106,985,808	10,771,300	7,536,451	120,963,910	114,522,259
1942	107,701,010	105,583,801	17,566,640	10,810,977	125,267,650	116,394,778
1943	82,412,380	83,397,757	17,235,700	11,346,272	99,648,080	94,744,029
1944	64,795,490	66,144,499	18,285,060	12,556,676	83,080,550	78,701,175

Concrete and road metal and railroad ballast sold or used by producers in the United States in 1944, by States

State	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama.....	66, 220	\$79, 186	(1)	(1)	66, 220	\$79, 186
Alaska.....	(1)	(1)	(1)	(1)	(1)	(1)
Arizona.....	69, 040	58, 322			69, 040	58, 322
Arkansas.....	182, 520	178, 014	98, 580	\$58, 756	281, 100	236, 770
California.....	5, 946, 960	4, 569, 580	192, 590	169, 935	6, 139, 550	4, 739, 515
Colorado.....	137, 090	97, 389	(1)	(1)	137, 090	97, 389
Connecticut.....	796, 640	816, 573	87, 060	78, 354	883, 700	894, 927
Delaware.....	9, 970	14, 958			9, 970	14, 958
Florida.....	1, 772, 710	1, 612, 647	14, 480	12, 303	1, 787, 190	1, 624, 950
Georgia.....	1, 249, 900	1, 254, 170	(1)	(1)	1, 249, 900	1, 254, 170
Hawaii.....	1, 539, 460	2, 609, 925	40	73	1, 539, 500	2, 609, 998
Idaho.....	280, 960	351, 959	(1)	(1)	280, 960	351, 959
Illinois.....	4, 196, 290	3, 846, 911	1, 016, 510	756, 547	5, 212, 800	4, 603, 458
Indiana.....	2, 303, 320	2, 295, 607	407, 530	367, 363	2, 710, 850	2, 662, 970
Iowa.....	1, 687, 690	1, 739, 869	105, 180	102, 158	1, 792, 870	1, 842, 027
Kansas.....	1, 000, 570	983, 686	724, 880	538, 600	1, 725, 450	1, 522, 286
Kentucky.....	2, 197, 110	2, 213, 556	524, 800	368, 939	2, 721, 910	2, 582, 495
Louisiana.....	(1)	(1)	(1)	(1)	(1)	(1)
Maine.....	70, 810	114, 866	(1)	(1)	70, 810	114, 866
Maryland.....	697, 200	750, 996	197, 660	218, 631	894, 860	969, 627
Massachusetts.....	684, 900	840, 369	320, 120	304, 357	1, 005, 020	1, 144, 726
Michigan.....	1, 560, 270	880, 653	166, 120	140, 481	1, 726, 390	1, 021, 134
Minnesota.....	955, 390	1, 078, 432	54, 770	32, 463	1, 010, 160	1, 110, 895
Missouri.....	2, 086, 090	1, 978, 059	1, 085, 890	490, 966	3, 171, 980	2, 379, 025
Montana.....	48, 360	43, 405	(1)	(1)	48, 360	43, 405
Nebraska.....	(1)	(1)	14, 000	30, 000	14, 000	30, 000
Nevada.....	48, 710	75, 118	(1)	(1)	48, 710	75, 118
New Jersey.....	1, 705, 240	2, 139, 413	156, 760	179, 684	1, 862, 000	2, 319, 097
New Mexico.....	(1)	(1)	(1)	(1)	591, 660	326, 701
New York.....	3, 631, 600	3, 881, 644	1, 063, 250	917, 008	4, 694, 850	4, 798, 652
North Carolina.....	4, 201, 680	5, 079, 820	290, 030	269, 558	4, 491, 710	5, 349, 378
Ohio.....	4, 857, 570	4, 534, 005	987, 390	789, 271	5, 844, 960	5, 323, 276
Oklahoma.....	646, 970	424, 547	3, 589, 910	835, 938	4, 236, 880	1, 260, 485
Oregon.....	1, 610, 810	2, 031, 960	39, 710	31, 114	1, 650, 520	2, 063, 074
Pennsylvania.....	4, 360, 770	4, 553, 022	922, 190	960, 991	5, 282, 960	5, 514, 013
Puerto Rico.....	120, 030	142, 406	16, 640	21, 933	136, 670	164, 330
Rhode Island.....	8, 060	12, 092			8, 060	12, 092
South Carolina.....	506, 180	586, 373	550, 470	520, 271	1, 056, 650	1, 106, 644
South Dakota.....	111, 310	148, 144	(1)	(1)	111, 310	148, 144
Tennessee.....	3, 441, 610	4, 274, 464	720, 410	530, 235	4, 162, 020	4, 804, 699
Texas.....	1, 189, 240	1, 137, 421	762, 240	491, 178	1, 951, 480	1, 628, 599
Utah.....	(1)	(1)	(1)	(1)	217, 520	99, 187
Vermont.....	10, 220	16, 572			10, 220	16, 572
Virginia.....	2, 314, 580	2, 519, 873	906, 500	808, 995	3, 221, 080	3, 328, 868
Washington.....	889, 750	970, 886	1, 036, 420	981, 883	1, 926, 170	1, 952, 769
West Virginia.....	715, 610	806, 891	383, 160	348, 891	1, 098, 770	1, 155, 782
Wisconsin.....	2, 541, 870	2, 441, 370	213, 680	178, 042	2, 755, 550	2, 619, 412
Wyoming.....	103, 320	87, 513	(1)	(1)	103, 320	87, 513
Undistributed.....	2, 240, 890	1, 871, 833	1, 636, 090	1, 111, 758	3, 867, 800	2, 557, 703
	64, 795, 490	66, 144, 499	18, 285, 060	12, 556, 676	83, 080, 550	78, 701, 175

¹ Included under "Undistributed."

² To avoid disclosing confidential information certain totals are somewhat incomplete, the figures not included being combined under "Undistributed."

COMMERCIAL AND NONCOMMERCIAL OPERATIONS

The accompanying table shows the production of crushed stone for concrete and road metal during recent years by Government agencies of various kinds, contrasted with that by commercial enterprises. For several years prior to 1940 Government-sponsored enterprises produced 29 to 46 percent of the total output. They consisted principally of make-work organizations designed to meet unemployment and, to a lesser extent, State, county, and city highway boards or commissions. War conditions brought about a radical change in the situation. Unemployment ceased to be a problem. Highway construction, except for military roads, was virtually suspended; consequently the output of stone by State and county organizations was very small. It is not

surprising therefore that noncommercial production dropped to only 9 percent of the total in 1943. However, the percentage increased to 12 in 1944.

Concrete and road metal sold or used by commercial and noncommercial operators in the United States, 1940-44

[Figures for "noncommercial operations" represent tonnages reported by States, counties, municipalities, and other Government agencies, produced either by themselves or by contractors expressly for their consumption, often with publicly owned equipment; they do not include purchases from commercial producers. Figures for "commercial operations" represent tonnages reported by all other producers]

Year	Commercial operations				Noncommercial operations				Total	
	Short tons	Average value per ton	Percent of change in quantity from preceding year	Percent of total quantity	Short tons	Average value per ton	Percent of change in quantity from preceding year	Percent of total quantity	Short tons	Percent of change in quantity from preceding year
1940.....	55,748,940	\$0.87	+6	60	37,065,150	\$1.02	-16	40	92,814,090	-4
1941.....	75,588,820	.94	+36	69	34,603,790	1.04	-7	31	110,192,610	+19
1942.....	92,251,930	.97	+22	86	15,449,080	1.05	-55	14	107,701,010	-2
1943.....	74,906,610	1.01	-19	91	7,505,770	1.05	-51	9	82,412,380	-23
1944.....	56,813,960	1.02	-24	88	7,979,540	1.06	+6	12	64,793,490	-21

GRANULES

Statistics on roofing granules of all kinds were compiled for the first time in 1943. Data are now available for 3 years, as follows.

Roofing granules sold or used in the United States, 1942-44, by kinds

Year	Natural		Artificially colored		Brick		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942.....	352,320	\$2,650,503	538,310	\$7,594,174	43,230	\$636,961	933,860	\$10,881,638
1943.....	287,090	2,190,143	543,870	7,745,452	47,650	716,685	878,610	10,652,280
1944.....	287,080	2,210,379	637,090	9,313,356	65,830	1,005,964	990,000	12,529,699

METHODS OF TRANSPORTATION

The following table shows the quantities of commercial crushed stone for concrete and road metal conveyed during 1943 and 1944 by each of the principal methods of transportation. During 1942 and 1943 there was a trend from truck to rail haulage; but in 1944 it was reversed, truck haulage assuming about the same proportions as in 1941.

*Stone for concrete and road metal sold or used by commercial producers in the United States, 1943-44, by methods of transportation*¹

Method of transportation	1943		1944	
	Short tons	Percent of total	Short tons	Percent of total
Truck.....	41,457,070	55	36,835,560	65
Rail.....	22,248,420	30	15,593,350	27
Waterway.....	3,241,420	4	1,813,980	3
Unspecified.....	7,959,700	11	2,573,060	5
	74,906,610	100	56,815,950	100

¹ For practical purposes the entire output of noncommercial operations commonly is moved by truck. Including noncommercial production, crushed stone for concrete and road metal moved as follows—1943: Truck 59 percent, rail 27 percent, water 4 percent, and unspecified 10 percent; 1944: Truck 69 percent, rail 24 percent, water 3 percent, and unspecified 4 percent.

GRANITE

Sales of crushed and broken granite declined 21 percent in both quantity and value in 1944 compared with 1943. Riprap sales were nearly three times as great as in 1943 because of an unusual demand in California for stone to be used in breakwater and jetty construction. The average selling price per ton was 25 cents higher than in 1943. Sales for concrete aggregate and road stone, the largest use, were only about two-thirds as great as in 1943, and the value of sales was even lower as the price per ton declined 10 cents. A low level of sales was to be expected because of inactivity in highway and building construction. Railroad ballast sales gained 4 percent in both quantity and value. The extremely heavy burden of transportation placed upon the rail lines in 1944 made it imperative that road beds be kept in condition. The average sales value of ballast remained unchanged. A moderate gain in sales for other uses was due primarily to increased demands for poultry grit.

The number of individual operations supplying noncommercial crushed stone cannot be determined with any degree of accuracy from the reports submitted. Therefore, in the accompanying tables covering granite and other kinds of crushed and broken stone, the number of active plants is not given. For many years before 1939, when noncommercial production was less important, such figures appeared in the tables.

Granite (crushed and broken stone) sold or used by producers in the United States in 1944, by States and uses

State	Riprap		Crushed stone				Other uses ¹		Total	
	Short tons	Value	Concrete and road metal		Railroad ballast		Short tons	Value	Short tons	Value
			Short tons	Value	Short tons	Value				
Alaska.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Arizona.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
California.....	668,390	\$1,136,033	(1)	(1)	(1)	(1)	(1)	(1)	1,621,250	\$1,726,378
Colorado.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Connecticut.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Delaware.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Georgia.....	(1)	(1)	9,970	\$14,958	(1)	(1)	(1)	(1)	9,970	14,958
Idaho.....	(1)	(1)	1,034,670	1,033,157	(1)	(1)	73,000	\$248,000	1,273,680	1,410,951
Maine.....	700	1,255	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Maryland.....	38,550	78,982	27,710	41,102	3,000	\$4,500	(1)	(1)	69,260	6,738
Massachusetts.....	(1)	(1)	176,670	223,209	(1)	(1)	(1)	(1)	197,840	124,564
Minnesota.....	(1)	(1)	41,710	43,161	(1)	(1)	7,540	22,616	80,910	247,745
Missouri.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Montana.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
New Jersey.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
New York.....	(1)	(1)	1,046,550	1,250,298	290,030	260,558	(1)	(1)	9,400	12,817
North Carolina.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	1,401,980	1,682,609
Oklahoma.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Pennsylvania.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Rhode Island.....	5,500	5,540	8,090	12,092	550,470	520,271	930	1,106	14,490	18,744
South Carolina.....	(1)	(1)	405,860	455,855	(1)	(1)	(1)	(1)	1,001,850	995,658
Vermont.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Virginia.....	(1)	(1)	364,500	474,430	282,670	317,126	(1)	(1)	653,760	799,185
Washington.....	(1)	(1)	(1)	(1)	(1)	(1)	11,320	57,433	36,310	79,187
Wisconsin.....	(1)	(1)	(1)	(1)	(1)	(1)	377,920	446,341	79,120	50,395
Undistributed.....	196,160	267,607	1,189,360	920,941	284,370	225,819	(1)	(1)	658,250	810,010
Average unit value.....	909,300	1,489,423	4,321,060	4,469,212	1,410,540	1,337,276	470,710	775,496	7,111,610	8,071,407
		\$1.64		\$1.03		\$0.95		\$1.65		\$1.13

¹ Includes stone used for poultry grit and stone sand.² Included under "Undistributed."

BASALT AND RELATED ROCKS (TRAP ROCK)

Sales of crushed and broken trap rock were 2 percent less and the value was 3 percent less in 1944 than in 1943. This classification includes the dark igneous rocks—basalt, gabbro, and diorite. The value per ton declined from \$1.23 to \$1.22. Sales of riprap declined greatly, but the value per ton increased 27 cents. Stone used as aggregate and for highways declined moderately, but sales of railroad ballast increased 56 percent. The value per ton for these major uses remained unchanged.

Basalt and related rocks (trap rock) (crushed and broken stone) sold or used by producers in the United States in 1944, by States and uses

State	Riprap				Crushed stone				Other uses ¹		Total	
	Short tons		Value		Concrete and road metal		Railroad ballast		Short tons	Value	Short tons	Value
					Short tons	Value	Short tons	Value				
California.....	173,000		\$258,215		1,122,690	\$1,054,317	49,740	\$54,866	9,560	\$4,640	1,354,900	\$1,372,038
Colorado.....					(¹)	(²)					(¹)	(²)
Connecticut.....	6,180		5,864		796,640	816,573	87,060	78,354			889,880	900,791
Hawaii.....	9,280		22,865		1,539,460	2,609,925	40	73	374,400	207,360	1,923,180	2,840,223
Idaho.....	(¹)		(²)		280,960	351,959	(¹)	(²)			300,010	379,584
Maine.....					(¹)	(²)					(¹)	(²)
Maryland.....					(¹)	(²)					(¹)	(²)
Massachusetts.....	5,080		3,596		425,590	516,010	320,120	304,357	30,000	67,500	348,110	415,547
Michigan.....					(¹)	(²)					781,390	891,463
Minnesota.....	(¹)		(²)		(¹)	(²)					(¹)	(²)
Montana.....	64,160		124,560		1,575,730	1,961,165	(¹)	(²)	(¹)	(²)	81,740	55,734
New Jersey.....	720		288		657,690	823,384	196,030	247,983			1,834,330	2,305,259
New York.....					(¹)	(²)					854,440	1,071,655
North Carolina.....					(¹)	(²)					(¹)	(²)
Oregon.....	48,090		20,878		1,579,810	1,969,960	(¹)	(²)	(¹)	(²)	1,666,000	2,015,931
Pennsylvania.....	630		633		498,590	630,153	478,520	494,555			977,710	1,125,341
Rhode Island.....					2,240	2,700	2,430	2,578			4,670	5,278
Texas.....					(¹)	(²)	(¹)	(²)			(¹)	(²)
Virginia.....					(¹)	(²)					(¹)	(²)
Washington.....	100		240		239,790	339,643					239,980	339,883
Wisconsin.....	241,220		286,388		831,990	967,468	1,036,420	981,853	5,920	212	2,171,550	2,235,951
Undistributed.....	42,080		24,359		498,270	594,457	588,360	582,642	149,580	728,997	596,850	1,186,922
Average unit value.....	591,230		747,886		10,105,420	12,637,714	2,758,720	2,747,201	569,460	1,008,709	14,024,830	17,141,600
			\$1.26			\$1.23		\$1.00		\$1.77		\$1.22

¹ Includes stone sold for base course, all material, roofing granules, and unspecified uses. ² Included under "Undistributed."

MARBLE

In the manufacture of marble blocks much waste accumulates. Some of it is marketed as terrazzo, stucco, or marble flour, and it also finds outlets for the same uses as those to which limestone is applied. It may be sold as agricultural limestone, as a filler, or as road stone or concrete aggregate. The great variation in unit value in different States, as indicated in the accompanying table, is due to the diversity in price among highly refined or commonplace uses.

Marble (crushed and broken stone) sold by producers in the United States in 1944, by States ¹

State	Active plants	Short tons	Value	State	Active plants	Short tons	Value
Alabama.....	2	(?)	(?)	Utah.....	1	6,000	\$70,800
Arkansas.....	1	300	\$120	Virginia.....	1	830	8,270
California.....	2	(?)	(?)	Washington.....	5	(?)	(?)
Maryland.....	1	920	11,071	Undistributed.....		53,640	235,175
Missouri.....	2	1,700	8,404				
New York.....	1	16,950	112,189	Total.....	21	100,810	507,240
Tennessee.....	4	16,470	33,121	Average unit value.....			\$5.03
Texas.....	1	4,000	28,000				

¹ Includes stone used for agriculture, artificial stone, crushed stone, magnesite, mineral food, poultry grit, riprap, shingles, spalls, stucco, terrazzo, tile, and whitening (excluding marble whitening made by companies that purchase their marble).

² Included under "Undistributed."

LIMESTONE

Sales of limestone were reported to the Bureau of Mines from 44 States in 1944. Because of its wide distribution and relatively low cost of production it is used more extensively than other types of stone in the United States. In 1944 limestone constituted 74 percent of all crushed and broken stone sold (excluding that used for making cement and lime). Metallurgical stone was in strong demand in 1944 because nearly all furnaces were operated at approximately 100 percent of capacity. Agricultural limestone sales increased 30 percent in tonnage compared with 1943. Production was stimulated by the high purchasing power of farmers, by assistance from the Agricultural Adjustment Administration and the War Food Administration, and by Government financing. M. P. R. 386, governing prices of agricultural liming materials, which permitted an advance in ceiling prices when justified by increases in production costs, was revised in October 1944, permitting a more liberal upward adjustment.

Sales of crushed limestone in 1944 were 10 percent lower in quantity and 7 percent lower in value than in 1943. The principal decrease was in stone used for concrete aggregate and for highway construction. Sales for miscellaneous uses are indicated in the second table following.

Limestone (crushed and broken stone) sold or used by producers in the United States in 1944, by States and uses

State	Riprap		Fluxing stone		Crushed stone				Agriculture		Other		Total	
	Short tons	Value	Short tons	Value	Concrete and road metal		Railroad ballast		Short tons	Value	Short tons	Value	Short tons	Value
					Short tons	Value	Short tons	Value						
Alabama	(1)	(1)	1,842,750	\$1,598,205	66,220	\$79,186	(1)	(1)	302,150	\$260,983	247,100	\$992,551	2,460,560	\$2,033,452
Arizona	(1)	(1)	47,630	47,340	5,150	8,875	(1)	(1)	80,370	136,060	(1)	(1)	52,780	56,216
Arkansas	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	128,190	281,067
California	2,310	\$1,930	216,970	477,510	476,510	408,688	(1)	(1)	(1)	(1)	546,220	1,606,706	1,247,720	2,393,853
Colorado	(1)	(1)	389,060	275,652	(1)	(1)	(1)	(1)	47,100	163,384	27,750	69,862	420,250	347,814
Connecticut	390	213	(1)	(1)	(1)	(1)	(1)	(1)	89,270	30,352	853,170	673,947	137,850	237,867
Florida	(1)	(1)	1,772,710	1,612,647	(1)	(1)	14,480	\$12,303	97,460	155,069	14,220	323,190	730,020	2,600,402
Georgia	(1)	(1)	199,230	221,013	(1)	(1)	(1)	(1)	(1)	(1)	37,550	31,081	414,360	707,305
Hawaii	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	17,560	31,081
Idaho	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	22,600	34,221
Illinois	56,770	69,998	758,200	758,555	4,174,850	3,829,757	1,016,510	756,547	4,112,350	4,294,807	534,850	961,097	10,655,330	10,670,101
Indiana	24,840	25,734	2,290	1,233	2,303,320	2,293,607	407,530	367,363	1,206,630	1,327,175	166,890	184,499	4,031,090	4,201,321
Iowa	145,130	104,543	20,750	20,695	1,687,690	1,739,869	105,180	102,158	1,572,320	1,922,312	31,940	223,428	3,653,090	4,175,065
Kansas	165,700	164,387	(1)	(1)	7,004,790	890,770	463,350	424,896	207,420	270,052	(1)	(1)	1,555,970	1,801,490
Kentucky	43,860	22,246	(1)	(1)	2,197,110	2,213,556	524,800	368,839	799,030	864,814	(1)	(1)	3,065,540	3,470,725
Louisiana	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	1,079,150	824,294
Maine	140	143	31,400	46,257	510	1,421	(1)	(1)	22,720	79,727	22,760	49,700	802,590	1,080,294
Massachusetts	(1)	(1)	(1)	(1)	665,490	701,594	(1)	(1)	37,980	107,317	(1)	(1)	206,490	680,323
Michigan	20,370	15,966	24,150	35,531	140	245	(1)	(1)	151,060	514,798	31,130	138,759	206,490	680,323
Minnesota	19,220	26,710	9,121,350	4,607,612	1,590,270	890,653	166,120	140,481	567,420	316,190	4,330,820	2,652,143	15,706,350	8,613,245
Mississippi	(1)	(1)	(1)	(1)	913,680	1,035,271	(1)	(1)	204,700	275,358	36,400	95,168	1,408,770	1,948,158
Missouri	240,880	374,475	13,370	18,541	1,537,610	1,846,006	336,290	259,686	1,113,140	1,537,284	281,200	729,523	3,522,460	4,779,518
Montana	(1)	(1)	119,040	117,559	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	3,152,210	164,079
Nebraska	(1)	(1)	(1)	(1)	(1)	(1)	14,000	30,000	(1)	(1)	(1)	(1)	169,720	483,563
Nevada	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
New Jersey	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
New Mexico	194,320	233,115	79,610	73,283	2,882,020	2,978,745	867,220	669,025	453,590	1,426,779	1,831,230	1,192,200	6,337,940	6,378,157
New York	(1)	(1)	(1)	(1)	227,050	279,887	(1)	(1)	(1)	(1)	(1)	(1)	3,318,430	392,108
North Carolina	22,640	21,780	5,874,110	4,445,797	4,857,570	4,534,005	987,390	789,271	2,122,090	2,678,953	933,810	1,248,575	14,707,610	13,718,387
Ohio	137,240	138,835	(1)	(1)	406,200	391,078	346,070	298,268	(1)	(1)	32,510	40,890	1,155,840	1,007,260
Oklahoma	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	19,220	60,565	(1)	(1)	51,090	124,185
Oregon	44,700	52,954	9,754,470	9,886,150	3,526,540	3,511,141	143,670	466,436	1,090,510	2,848,091	1,158,820	2,044,313	16,021,710	18,869,685
Pennsylvania	(1)	(1)	(1)	(1)	117,790	139,706	(1)	(1)	(1)	(1)	(1)	(1)	137,570	167,333
Puerto Rico	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	174,270	222,015
South Carolina	32,290	40,780	19,000	19,000	100,320	130,518	(1)	(1)	(1)	(1)	(1)	(1)	113,110	146,430
South Dakota	43,720	66,894	35,590	39,071	3,441,610	4,274,464	720,410	530,235	1,670,800	1,777,790	111,940	183,398	6,024,070	6,871,861
Tennessee	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)

See footnotes at end of table.

Limestones (crushed and broken stone) sold or used by producers in the United States in 1944, by States and uses—Continued

State	Riprap		Fluxing stone		Crushed stone				Agriculture		Other		Total	
					Concrete and road metal		Railroad ballast							
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Texas.....	(1)	(1)	182,430	\$156,781	937,050	\$976,711	702,240	\$491,178	(1)	(1)	391,270	\$415,823	2,441,680	\$2,115,797
Utah.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	25,080	89,950	357,140	278,455
Vermont.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	86,960	612,313
Virginia.....	360	\$728	418,980	443,548	1,695,760	1,696,713	598,480	475,607	1,039,700	\$1,098,663	741,520	830,730	4,494,800	4,535,989
Washington.....	(1)	(1)	6,060	5,392	1,760	3,418	383,160	348,891	19,660	84,364	119,880	237,999	147,360	831,173
West Virginia.....	(1)	(1)	1,805,140	1,960,933	679,200	764,187	213,680	178,042	129,510	232,248	(1)	(1)	2,340,850	3,547,225
Wisconsin.....	62,360	102,849	70,040	48,960	2,418,120	2,314,017	(1)	(1)	1,307,820	1,762,714	32,280	24,277	4,104,300	4,460,559
Wyoming.....	152,860	160,222	(1)	(1)	19,860	19,524	(1)	(1)	(1)	(1)	(1)	(1)	307,340	308,315
Undistributed.....	174,030	141,913	244,120	308,411	432,610	325,056	974,310	570,202	392,130	712,788	1,614,010	3,083,577	263,930	928,434
Average unit value.....	1,584,060	1,828,330	31,080,330	25,130,113	40,180,460	40,166,631	9,361,070	7,275,833	18,941,220	25,316,219	14,197,350	18,209,842	115,344,490	117,923,988
		\$1.15		\$0.81		\$1.00		\$0.78		\$1.34		\$1.28		\$1.02

1 Included under "Undistributed."

Limestone (crushed and broken stone) sold or used by producers in the United States for miscellaneous uses, 1943-44

Use	1943		1944	
	Short tons	Value	Short tons	Value
Alkali works.....	6,867, 190	\$4, 189, 940	6, 990, 370	\$4, 279, 141
Calcium carbide works.....	526, 920	538, 425	509, 860	476, 292
Coal-mine dusting.....	194, 360	497, 258	196, 470	624, 217
Filler (not whitening substitute):				
Asphalt.....	440, 510	887, 908	449, 560	855, 480
Fertilizer.....	276, 410	405, 334	373, 970	599, 932
Other.....	178, 250	570, 664	236, 720	677, 522
Filter beds.....	36, 260	74, 586	20, 880	44, 064
Glass factories.....	504, 930	811, 991	512, 710	820, 150
Limestone sand.....	428, 010	387, 896	380, 230	278, 970
Limestone whitening ¹	296, 370	2, 068, 098	352, 490	2, 554, 728
Magnesium metal (dolomite).....	887, 830	891, 350	652, 610	983, 359
Magnesia works (dolomite) ²	203, 240	242, 974	220, 160	450, 328
Mineral food.....	293, 490	1, 394, 705	254, 150	1, 193, 706
Mineral (rock) wool.....	89, 590	101, 832	43, 480	45, 610
Paper mills.....	384, 960	699, 266	375, 490	630, 425
Poultry grit.....	119, 080	700, 163	130, 450	701, 194
Refractory (dolomite).....	1, 105, 560	1, 120, 258	1, 075, 050	1, 130, 022
Road base.....	1, 984, 460	1, 544, 409	885, 460	706, 341
Stucco, terrazzo, and artificial stone.....	21, 270	129, 522	12, 460	80, 518
Sugar factories.....	347, 320	658, 209	254, 410	431, 462
Other uses ³	292, 790	480, 927	202, 140	438, 703
Use unspecified.....	66, 630	186, 876	68, 230	207, 678
	15, 545, 430	18, 582, 591	14, 197, 350	18, 209, 842

¹ Includes stone for filler for calcimine, crayons, explosives, foundry facing powder, leather goods, linoleum, paint, paper, phonograph records, plastics, pottery, putty, roofing, rubber, wire coating, and unspecified uses.

² Includes stone for refractory magnesia.

³ Includes stone for acid neutralization, brick glazing, carbon dioxide, ceramics, chemicals (unspecified), concrete blocks and pipes, dye, electric products, motion-picture snow, oil-well drilling, rayon, rice milling, spalls, spray, target marker, and water treatment.

Dolomite (calcium-magnesium carbonate) has a variety of uses. Dead-burned dolomite is used as a refractory lining for metallurgical furnaces, and statistical data on this product (which is closely allied to lime) are given in the chapter on Lime of this volume. Dolomite in the raw state is also used as a refractory, particularly for patching furnace floors. Dolomite is also used as a source of magnesia (MgO) which may be applied to refractory use, employed for heat insulation, or used in various other ways. In 1943 for the first time dolomite was used extensively as a source of magnesium metal. This use has declined owing the cut-back in the metal program.

Sales of dolomite and its primary product of calcination—dolomitic lime—for certain uses are covered in the following table.

Dolomite and dolomitic lime sold or used by producers in the United States for specified purposes, 1943-44

	1943	1944
Dolomite for—		
Basic magnesium carbonate: ¹		
Short tons.....	203, 240	220, 160
Value.....	\$242, 974	\$450, 328
Magnesium metal:		
Short tons.....	887, 830	652, 610
Value.....	\$891, 350	\$983, 359
Refractory uses:		
Short tons.....	1, 105, 560	1, 075, 050
Value.....	\$1, 120, 258	\$1, 130, 022
Dolomitic lime for—		
Refractory (dead-burned dolomite):		
Short tons.....	1, 276, 725	1, 290, 790
Value.....	\$11, 243, 017	\$11, 441, 612
Paper mills:		
Short tons.....	72, 000	46, 000
Value.....	\$524, 000	\$347, 000
Total (calculated as raw stone)..... short tons.....	4, 894, 000	4, 621, 000

¹ Includes dolomite for refractory magnesia.

Fluxing limestone has attained such importance that the following table has been prepared indicating its principal uses.

Sales of fluxing limestone, 1940-44, by uses

Year	Blast furnaces		Open-hearth plants		Other smelters ¹		Other metal-lurgical ²		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	15,611,720	\$10,638,341	6,500,680	\$4,462,852	342,240	\$278,726	402,270	\$358,968	22,856,910	\$15,738,887
1941.....	20,244,510	14,832,938	6,332,210	4,469,838	481,100	398,839	374,700	362,544	27,432,520	20,064,139
1942.....	23,663,630	18,523,158	5,843,820	4,886,157	494,720	460,270	257,080	277,728	30,259,250	24,147,313
1943.....	24,755,920	18,785,578	5,932,900	4,899,369	671,990	581,325	209,840	239,295	31,570,650	24,505,567
1944.....	24,045,890	18,954,798	6,158,870	5,251,987	557,830	547,277	317,740	376,051	31,080,330	25,130,113

¹ Includes flux for copper, gold, lead, zinc, and unspecified smelters.

² Includes flux for foundries, and for cupola and electric furnaces.

Limestone is employed not only in the raw state but also for the manufacture of cement and lime. The latter industries are covered in separate chapters of the Minerals Yearbook. It is of interest, however, to show in one table, as follows, the total tonnage of limestone consumed for all purposes.

Limestone sold or used for all purposes in the United States, 1942-44, in short tons

Use	1942	1943	1944
Limestone (as given in this report) (approximate).....	142,488,000	128,980,000	115,506,000
Portland cement (including "cement rock") ¹	47,657,000	35,867,000	24,148,000
Natural cement ("cement rock") ¹	12,208,000	13,193,000	12,947,000
Lime ²	202,353,000	178,040,000	152,601,000

¹ Reported in terms of cement in chapter on Cement.

² Reported in terms of lime in chapter on Lime.

SANDSTONE

Sales of crushed and broken sandstone declined 13 percent in quantity and 1 percent in value in 1944 compared with 1943. Quartzite (ganister) sold for the manufacture of silica brick dropped 23 percent in quantity and 18 percent in value from the peak of 1943. The average price per ton increased 14 cents. Riprap sales were lower, but stone for concrete aggregate and road building increased substantially. Also the average price per ton was 27 cents higher than in 1943. Sales of railroad ballast and of stone for miscellaneous uses declined greatly.

Sandstone (crushed and broken stone) sold or used by producers in the United States in 1944, by States and uses

State	Refractory stone (gallster)		Riprap		Crushed stone				Other uses ¹		Total	
					Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama.....	(²)	(²)									(²)	(²)
Arizona.....			(²)	(²)							(²)	(²)
Arkansas.....											(²)	(²)
California.....	(²)	(²)	124,560	\$116,088	554,750	\$432,732	(²)	(²)	(²)	(²)	1,021,620	\$762,280
Colorado.....	(²)	(²)	(²)	(²)							26,120	41,751
Illinois.....	550	\$4,774									4,774	
Kansas.....					61,100	62,238	55,000	\$52,250			116,100	114,488
Massachusetts.....												(²)
Minnesota.....			440	477	(²)	(²)					440	477
Missouri.....											(²)	(²)
New Mexico.....	(²)	(²)			26,040	43,070			(²)	(²)	88,700	139,993
New York.....					(²)	(²)					(²)	(²)
North Carolina.....					51,940	78,447			(²)	(²)	1,176,264	
Ohio.....	90,570	628,775	(²)	(²)	(²)	(²)			(²)	(²)	227,320	1,176,264
Oklahoma.....			(²)								(²)	(²)
Oregon.....			240	180	31,000	62,000	(²)	(²)	(²)	(²)	31,240	62,180
Pennsylvania.....	653,270	1,279,305	(²)	(²)	255,180	305,835	(²)	(²)	(²)	(²)	993,810	1,678,727
South Dakota.....	75,820	135,528	10,000	12,500	32,700	45,844	(²)	(²)	(²)	(²)	124,950	203,220
Tennessee.....					(²)	(²)					29,170	2,421
Texas.....	(²)	(²)	(²)	(²)							(²)	(²)
Utah.....					14,530	19,078	25,350	16,260	5,580	\$3,948	101,620	117,213
Virginia.....	56,160	77,927	(²)	(²)	(²)	(²)	(²)	(²)			100,960	140,004
West Virginia.....									(²)	(²)	433,660	2,254,114
Wisconsin.....	149,950	268,722									48,800	34,384
Wyoming.....									671,020	2,580,622	3,004,390	3,593,501
Undistributed.....	182,260	326,965	182,560	152,777	2,924,280	3,493,245	105,630	126,274				
Average unit value.....	1,217,580	2,722,026	369,770	360,469	3,902,580	4,464,042	185,980	194,784	676,600	2,584,570	6,352,510	10,325,891
		\$2.24		\$0.97		\$1.14		\$1.05		\$3.82		\$1.63

¹ Includes sandstone for chemical, fill material, filter stone, poultry grit, rock wool, roofing granules, spalls, stone sand, and waste.
² Included under "Undistributed."

MISCELLANEOUS STONE

Crushed and broken stone, other than the five principal varieties already discussed, includes light-color volcanic rocks, schists, boulders from river beds, serpentine, and flint. The following table shows sales of these types, by States and uses, in 1944; such sales increased 8 percent in quantity and 19 percent in value over 1943.

Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1944, by States and uses

State	Riprap		Crushed stone				Other uses ¹		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alaska.....										
Arizona.....			(²) 63,890	(²) \$49,447					(²) 63,890	(²) \$49,447
Arkansas.....			(²)	(²)	(²)				(²)	(²)
California.....	(²) 473,500	(²) \$446,725	3,793,010	2,673,843	(²)	(²)	(²)	(²)	4,649,420	3,226,068
Colorado.....			(²)	(²)	(²)				(²)	(²)
Georgia.....			(²)	(²)	(²)				(²)	(²)
Illinois.....			21,440	17,154					21,440	17,154
Kansas.....			* 234,680	* 60,678	204,530	\$61,484			* 439,210	* 122,162
Maine.....			(²)	(²)	(²)				38,820	67,550
Maryland.....	(²) 900	(²) 1,107	4,000	8,300					4,900	9,407
Massachusetts.....			(²)	(²)	(²)				(²)	(²)
Michigan.....			(²)	(²)	(²)				(²)	(²)
Minnesota.....			(²)	(²)	(²)				(²)	(²)
Missouri.....			* 548,480	* 132,050	749,630	134,280	* 24,840	* \$53,105	* 1,322,950	* 319,435
Nevada.....			(²)	(²)	(²)				(²)	(²)
New Jersey.....			(²)	(²)	(²)				(²)	(²)
New York.....			(²)	(²)	(²)				(²)	(²)
North Carolina.....	(²)	(²)	(²)	(²)	(²)				(²)	(²)
Ohio.....			(²)	(²)	(²)				(²)	(²)
Oklahoma.....			* 150,680	* 33,469	3,243,840	567,670			* 3,394,520	* 601,139
Oregon.....			77,490	105,893					197,140	165,952
Pennsylvania.....			(²)	(²)	(²)				143,000	637,995
Puerto Rico.....	710	856								
Rhode Island.....			(²)	(²)	(²)				(²)	(²)
South Carolina.....			(²)	(²)	(²)				(²)	(²)
South Dakota.....			(²)	(²)	(²)				(²)	(²)
Texas.....	(²)	(²)	(²)	(²)	(²)				(²)	(²)
Virginia.....	(²)	(²)	(²)	(²)	(²)				(²)	(²)
Washington.....	(²)	(²)	(²)	(²)	(²)				263,490	180,329
West Virginia.....	(²)	(²)	(²)	(²)	(²)				30,231	30,231
Wisconsin.....	(²)	(²)	(²)	(²)	(²)				180,790	93,418
Wyoming.....			(²)	(²)	(²)				(²)	(²)
Undistributed.....	78,620	70,707	1,390,090	1,700	370,750	238,038	528,620	302,097	2,210	1,700
Average unit value.....	553,730	519,395	6,285,970	4,406,900	4,568,750	1,001,472	618,260	898,448	1,253,500	1,213,552
		\$0.94		\$0.70		\$0.22		\$1.43		\$0.57

¹ Includes stone used for filler (unspecified), ornamental concrete, poultry grit, refractory, road base, roofing granules, stone sand, stucco, and tennis courts.² Included under "Undistributed."³ Chats; figures collected by Joplin (Mo.) office of the Bureau of Mines.⁴ A small quantity of stone included with chats.

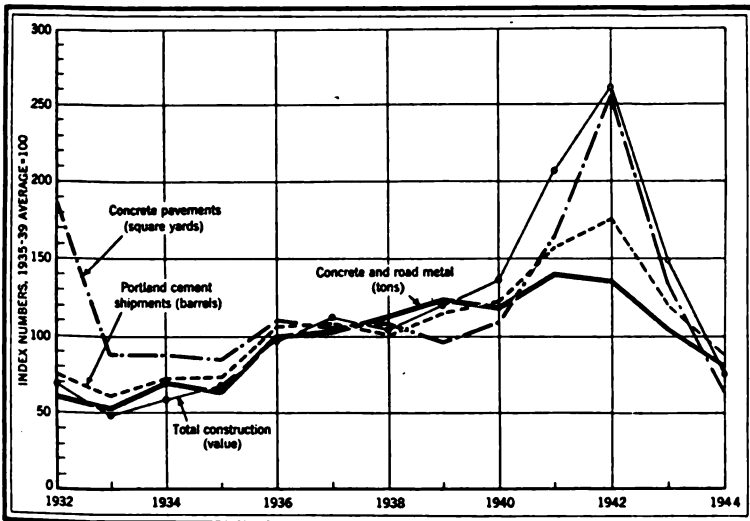


FIGURE 3.—Crushed-stone aggregates (concrete and road metal) sold or used in the United States compared with shipments of portland cement, total construction (value), and concrete pavements (contract awards, thousands of square yards), 1932-44. Data on construction and concrete pavements from Bureau of Foreign and Domestic Commerce.

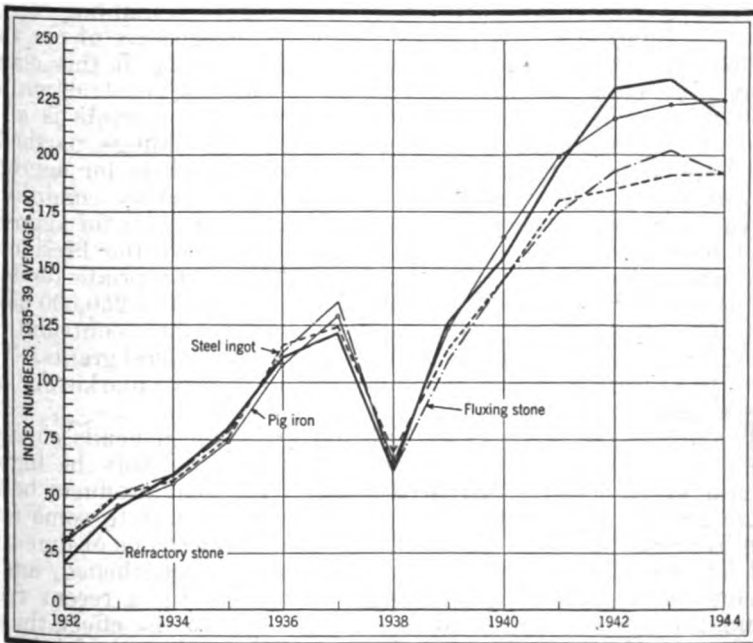


FIGURE 4.—Sales (tons) of fluxing stone and refractory stone, including that used in making lime, as recorded in the chapter on Lime compared with production of steel ingot and pig iron, 1932-44. Statistics of steel-ingot production compiled by American Iron and Steel Institute.

MARKETS

Large quantities of crushed stone are used as aggregate in concrete for both highway and building construction. It is to be expected therefore that crushed stone sales will follow the trend of cement shipments and the area of concrete pavements. These relationships are indicated in figure 3. With completion of nearly all major airfields and military roads, concrete pavement construction in 1944 dropped to the lowest point in many years. The area in square yards was less than half as great as in 1943. Building construction also declined to about one-half of its 1943 volume. Cement shipments were 26 percent less than in 1943. The decline of 21 percent in sales of crushed-stone aggregates was to be expected under these unfavorable conditions.

The metallurgical industries operated almost at maximum capacity during 1944. Pig-iron production of over 61 million tons surpassed its previous high record—that for 1943. The demand for fluxing stone was therefore maintained at a record level. Steel production of over 89 million tons was also the highest on record. To keep furnaces in repair under conditions of forced production placed a heavy burden on suppliers of dead-burned refractory dolomite and ganister for making silica brick. The close relationships of fluxing-stone output to pig-iron production and of refractory stone to steel-ingot manufacture over a period of years are indicated in figure 4.

FUTURE TRENDS

Crushed stone is used principally as aggregate in building construction and highways. As pointed out in the discussion of the future outlook for the dimension stone industries earlier in this chapter, there is an immense backlog of proposed building construction to be undertaken when conditions are favorable. As concrete is an important construction material for all types of buildings, particularly nonresidential, there is prospect of growing markets for aggregates for some years following reestablishment of peacetime conditions.

Highway construction offers more extensive markets for aggregates than building construction. A bill was signed by the President in December 1944 that authorized, but did not appropriate funds for, a postwar Federal expenditure on highways of \$1,673,250,000 as part of a \$3,173,250,000 3-year program. The States must contribute on a 50-50 matching basis to become eligible for the Federal grants. There is fairly definite prospect, therefore, of an extensive market for highway aggregates.

The volume of trade in agricultural limestone depends chiefly on the purchasing power of farmers which will probably be high for several years because extensive markets for food products both at home and abroad are forecast. Sales are governed to some extent also by the firmness of the conviction that applications of lime to the soil are beneficial. This conviction may be strengthened, and the volume of business correspondingly increased, by a recent recommendation of the War Food Administration¹ to the effect that, for best results, the quantity of liming materials used on the land should be increased to nearly three times the tonnage employed in the peak year 1944.

¹ U. S. Department of Agriculture, War Food Administration, A National Policy for Fertilizers and Liming Materials: February 1945, p. 4.

Markets for metallurgical, chemical, and refractory stone depend primarily upon the volume of industrial production. A moderate transition from military to peacetime production was under way shortly after the collapse of Germany, but extensive reconversion is not to be expected until after the fall of Japan. There is, however, an enormous unsatisfied demand for civilian goods which bears promise of high industrial activity following the conclusion of the war emergency.

FOREIGN TRADE²

For security reasons complete annual data covering foreign trade in stone have not been available for publication since 1940. Now that restrictions are lifted, figures for both imports and exports for 1941 to 1944 are presented in the accompanying tables. Exports are never large, and as their destinations are confined chiefly to countries of the Western Hemisphere they have not been affected greatly by the war. Imports from European countries declined very greatly. Granite and quartzite imports remained at relatively high levels, as they originated chiefly in Canada.

Stone imported for consumption in the United States, 1941-44, by classes

Class	1941		1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Marble, breccia, and onyx:								
In blocks, rough, etc. cubic feet	23,391	\$126,333	12,151	\$52,945	1,186	\$3,688	2,785	\$11,957
Sawed.....do	6	159	351	1,040	1	2		
Slabs or paving tiles superficial feet	413	737	4,303	1,976	15	7	316	409
All other manufactures.....do		6,408		9,182		5,639		18,023
		133,637		65,143		9,336		30,389
Granite:								
Dressed.....cubic feet	998	6,813	1,132	4,498	1,244	4,485	582	4,507
Rough.....do	19,081	27,457	24,523	48,621	28,031	42,470	21,979	38,115
	20,079	34,270	25,655	53,119	29,275	46,955	22,561	42,622
Quartzite.....short tons	106,979	190,964	99,117	176,775	69,487	133,978	128,857	300,223
Travertine stone.....cubic feet	3,103	5,054						
Stone (other):								
Dressed.....do		567		105		64		175
Rough (monumental or building stone).....cubic feet	1,250	5,580	3	5	1,346	724		
Rough (other).....short tons	58,062	38,029	41,455	30,767	41,280	31,957	46,031	40,590
Marble chip or granite.....do	155	1,128						
		45,904		30,877		32,745		40,765
Grand total.....do		409,859		325,914		223,014		413,999

Stone exported from the United States, 1941-44

Year	Marble and other building and monumental stone		Other manufactures of stone (value)
	Cubic feet	Value	
1941.....do	78,640	\$187,933	\$415,853
1942.....do	70,072	172,783	229,993
1943.....do	65,614	184,772	151,650
1944.....do	78,164	201,036	176,423

² Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

SLATE

By OLIVER BOWLES AND M. G. DOWNEY

SUMMARY OUTLINE

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SUMMARY

Although sales of slate as a whole gained 2 percent in quantity and 3 percent in value in 1944 compared with 1943 the increase was confined almost exclusively to granules and flour. Slate sold as dimension stone (that is, in the form of roofing slate, mill stock, flagstones, etc.) declined 17 percent in quantity and 12 percent in value. The total value of these products—\$1,720,958—was the lowest since 1934.

Roofing-slate sales fell 7 percent in quantity and 5 percent in value below the previous all-time low record of 1943. The average value per square in 1944 was \$9.00, whereas in 1943 it was \$8.75. In the Pennsylvania area sales were 9 percent lower in quantity and 5 percent in value than in 1943. In the New York-Vermont area, however, sales gained 54 percent in quantity and 45 percent in value. In the Buckingham region, Virginia, sales decreased 25 percent in quantity and 24 percent in value.

Sales of mill stock declined 23 percent in quantity and 24 percent in value. Blackboards and bulletin boards and the group of flagstones and related products were the only commodities to gain in sales; all other classifications experienced losses. The output of electrical slate decreased 37 percent in quantity and 42 percent in value from 1943. As building construction of types that employ slate was at a very low ebb in 1944, it is not surprising that structural and sanitary slate dropped 12 percent in quantity and 11 percent in value. Sales of blackboards and bulletin boards increased 8 percent in quantity and 20 percent in value.

Sales of vaults and covers decreased 10 percent in quantity but gained 6 percent in value. The output of billiard-table tops, which made a remarkable gain in 1943, reversed its trend of a year ago, with a decline of 43 percent in quantity and 35 percent in value. Sales of school slates, most of which are exported, declined 45 percent in quantity and 47 percent in value. The market for flagstones, stepping stones, and similar products was somewhat better; sales increased 10 percent in quantity and 22 percent in value.

Statistics of slate granules and flour are included in this chapter although they have little in common with the slate products already mentioned. Granules are, in fact, used in making roofing products that compete in the roofing-slate market, but most of the slate used in the manufacture of granules and flour is unsuited for other slate products. The gains of 5 percent in quantity and 12 percent in value of sales of granules and flour reflect the need for various forms of composition roofing in war housing and in maintenance and extension of other more or less temporary types of war construction. In 1944 the average sales value of granules, f. o. b. mill, was \$9.25 and of flour

\$3.92 per short ton, compared with \$8.71 and \$3.65, respectively, in 1943. Figures for sales of granules made of rock other than slate are given in the chapter of this volume on Stone.

The following table presents the principal statistical data for the slate industry in 1943 and 1944.

Salient statistics of the slate industry in the United States, 1943-44

	1943			1944				
	Quantity		Value	Quantity		Value	Percent of change in—	
	Unit of measurement	Approximate equivalent short tons		Unit of measurement	Approximate equivalent short tons		Quantity (unit as reported)	Value
Domestic production (sales by producers):	<i>Squares</i>			<i>Squares</i>				
Roofing slate.....	96,220	35,370	\$841,750	89,090	32,750	\$802,179	-7.4	-4.7
Mill stock:	<i>Sq. ft.</i>			<i>Sq. ft.</i>				
Electrical slate.....	550,790	4,730	451,427	349,480	2,930	264,088	-36.5	-41.5
Structural and sanitary slate.....	442,290	3,490	166,425	391,280	3,250	151,069	-11.5	-10.8
Grave vaults and covers.....	389,980	3,740	99,807	351,230	3,360	105,501	-9.9	+5.7
Blackboards and bulletin boards.....	466,160	1,160	100,981	502,750	1,270	121,048	+7.8	+19.9
Billiard-table tops.....	333,070	2,410	103,924	190,190	1,400	67,168	-42.9	-35.4
School slates.....	461,850	420	12,864	256,280	230	6,815	-44.5	-46.8
Total mill stock.....	2,644,140	15,950	938,368	2,041,210	12,440	715,689	-22.8	-23.7
Flagstones, etc. ¹	2,027,020	21,990	166,231	2,235,960	15,760	203,090	+10.3	+22.2
Total slate as dimension stone.....		73,310	1,946,349		60,950	1,720,958	-16.9	-11.6
Granules and flour.....		395,550	2,923,888		416,890	3,283,237	+5.4	+12.3
Grand total domestic production.....		468,860	4,870,237		477,840	5,004,195	+1.9	+2.8

¹ Square feet approximate. Number of pieces: 1943, 863,270; 1944, 479,030.

² Includes slate used for walkways, stepping stones, and miscellaneous uses.

SALES

Dimension slate.—The term "dimension slate" is applied to blocks or slabs of specified sizes and shapes. It includes all slate products except granules and flour. The following table shows sales of dimension slate for a 5-year period.

Slate (other than granules and flour) sold by producers in the United States, 1940-44

Year	Roofing			Mill stock		Other ¹		Total	
	Squares	Approximate equivalent short tons	Value	Approximate short tons	Value	Approximate short tons	Value	Approximate short tons	Value
1940.....	347,130	127,600	\$2,436,123	17,070	\$935,810	9,780	\$64,435	154,450	\$3,436,368
1941.....	378,980	140,830	3,180,766	18,680	1,076,814	21,480	152,254	180,990	4,409,834
1942.....	192,070	71,400	1,704,653	18,720	1,112,426	16,910	139,328	107,030	2,955,807
1943.....	96,220	35,370	841,750	15,950	938,368	21,990	166,231	73,310	1,946,349
1944.....	89,090	32,750	802,179	12,440	715,689	15,760	203,090	60,950	1,720,958

¹ Includes flagstones, walkways, stepping stones, and miscellaneous slate.

Figure 1 compares sales of roofing slate and mill stock with the number of new dwelling units and the value of new nonresidential building from 1925 to 1944. Roofing slate is used chiefly in residential building and therefore tends to follow the trend of activity in erection of new dwelling units. Other roofing materials compete with slate, and since 1938 slate sales have not kept pace with residential building. It is expected that a postwar revival of home building will rejuvenate the roofing-slate industry.

Mill-stock slate is used most widely in nonresidential building, and sales of mill stock have followed rather closely the trend of such construction since 1925. During the past 3 years sales of slate have been depressed relatively much less than nonresidential building, although both have maintained a low level of activity. A return to

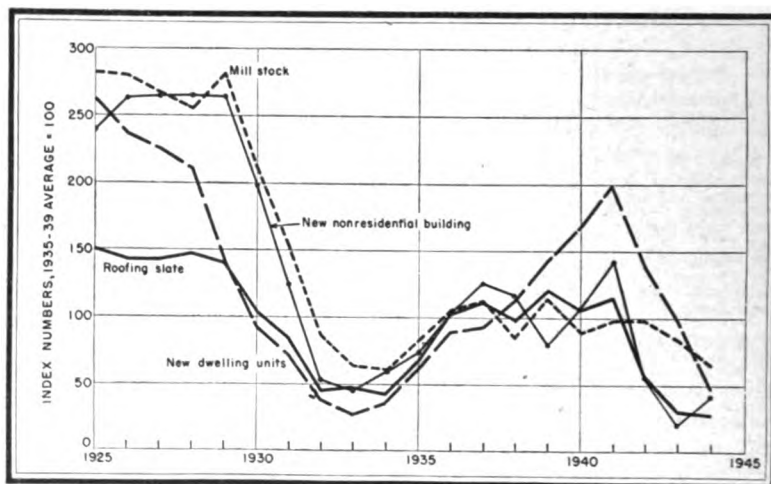


FIGURE 1.—Sales of roofing slate and mill stock compared with number of new dwelling units and value of new nonresidential building, 1925-44. Data on new nonresidential building from Bureau of Foreign and Domestic Commerce and on new dwelling units from Bureau of Labor Statistics.

the more permanent types of peacetime construction will stimulate a wider demand for structural slate.

Figure 2 presents graphically a statistical history of slate over a 30-year period, by uses. It is evident from this figure that the slate industry depreciates greatly during wars and depressions.

Figure 3 presents the history of slate production, by uses, on a quantity basis. The large-tonnage products that have a relatively low unit value assume greater prominence in this chart than in figure 2.

Granules and flour.—Granules are used chiefly in surfacing prepared roofing. Flour, most of which is recovered as a byproduct of the granule industry, is used as a filler in road-asphalt surface mixtures, paints, roofing mastic, linoleum, and various other products. The small gain in sales of granules in 1944 indicates that the demand for composition roofing materials did not recede. Such products are used both in new construction and in maintenance and repair of existing buildings. Sales for a 5-year period are indicated in the accompanying table.

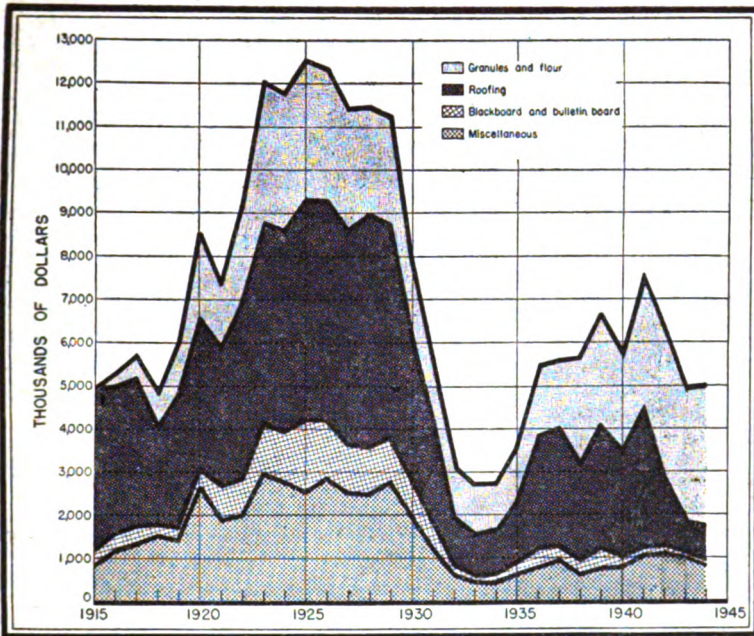


FIGURE 2.—Value of slate sold in the United States, 1915-44, by uses.

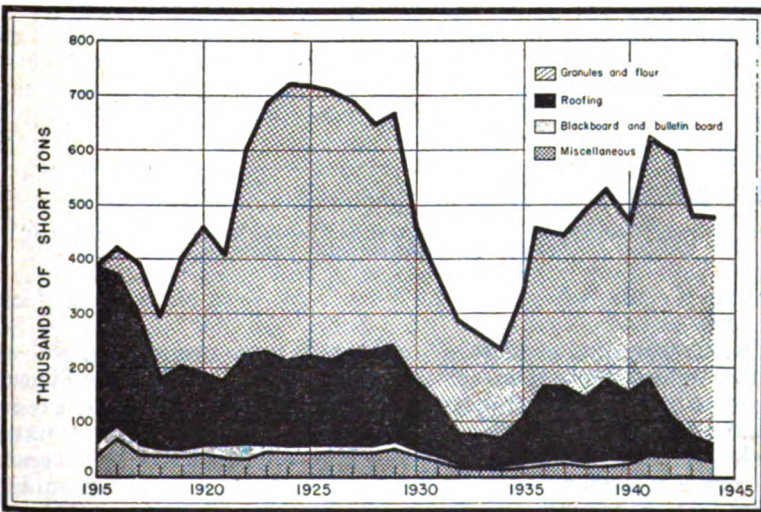


FIGURE 3.—Quantity of slate sold in the United States, 1915-44, by uses.

Crushed slate (granules and flour) sold by producers in the United States, 1940-44

Year	Granules		Flour		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	230, 440	\$2, 009, 151	88, 560	\$292, 750	319, 000	\$2, 301, 901
1941.....	323, 740	2, 708, 246	113, 930	397, 554	437, 670	3, 105, 800
1942.....	356, 510	2, 955, 562	127, 230	448, 854	483, 740	3, 404, 416
1943.....	292, 330	2, 547, 399	103, 220	376, 489	395, 550	2, 923, 888
1944.....	309, 170	2, 861, 014	107, 720	422, 223	416, 890	3, 283, 237

PRICES

The average price of roofing slate, f. o. b. quarry or mill, as reported to the Bureau of Mines, increased 25 cents a square in 1944 compared with 1943. In Pennsylvania, it increased 36 cents a square and in

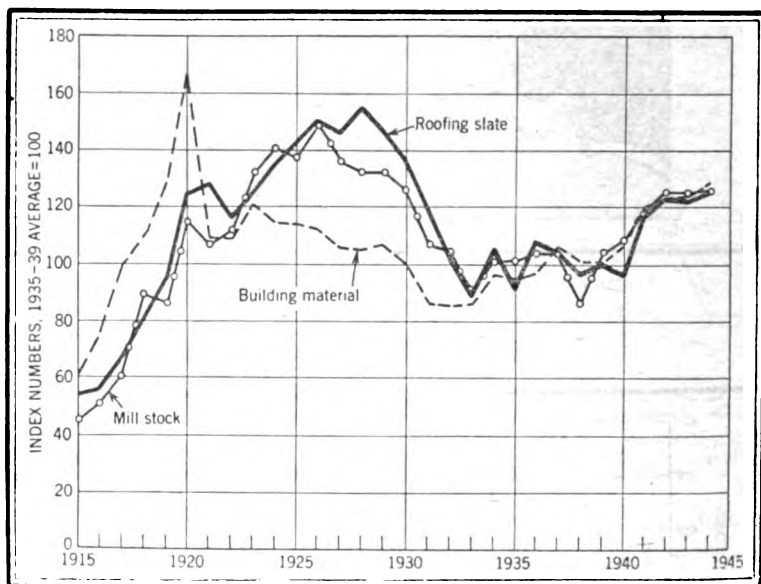


FIGURE 4.—Prices of slate compared with wholesale prices of building materials in general, 1915-44. Wholesale prices from Bureau of Labor Statistics.

Virginia 6 cents, whereas in the New York-Vermont area it declined 57 cents.

The average value of total mill stock remained unchanged at 35 cents a square foot, although prices of individual products fluctuated considerably. The average value of electrical slate declined 6 cents. Billiard-table tops increased 4 cents, vaults and covers 4 cents, and blackboards 2 cents a square foot, whereas the price of structural and sanitary slate remained unchanged. The sales value of granules increased 54 cents and of slate flour 27 cents a short ton.

Price history.—Figure 4 shows the trend of slate prices compared with prices of all building materials over a 30-year period. During recent years they have been in remarkably close accord.

REVIEW BY STATES AND DISTRICTS

The following table gives sales of slate in 1944, by States and uses.

Slate sold by producers in the United States in 1944, by States and uses

State	Operators	Roofing		Mill stock		Other uses (value) ¹	Total value
		Squares (100 square feet)	Value	Square feet	Value		
Arkansas.....	1	-----	-----	-----	-----	\$6, 102	\$6, 102
California.....	1	-----	-----	-----	-----	80, 959	80, 959
Georgia.....	1	-----	-----	-----	-----	(?)	(?)
Maryland.....	1	-----	-----	-----	-----	(?)	(?)
New York.....	5	140	\$3, 140	-----	-----	787, 953	791, 093
Pennsylvania ²	18	70, 220	614, 077	1, 727, 940	\$460, 559	753, 260	1, 827, 896
Vermont and Maine.....	12	9, 770	91, 890	313, 270	255, 130	1, 231, 549	1, 578, 559
Virginia.....	5	8, 960	93, 082	-----	-----	(?)	(?)
Undistributed.....	-----	-----	-----	-----	-----	626, 504	719, 586
Total: 1944.....	44	89, 090	802, 179	2, 041, 210	715, 689	3, 486, 327	5, 004, 195
1943.....	49	96, 220	841, 750	2, 644, 140	938, 368	3, 090, 119	4, 870, 237

¹ Flaring and similar products, granules, and flour.

² Included under "Undistributed."

³ For details of production in Pennsylvania, see following table.

Maine.—The slate quarries of the Monson district produce electrical slate primarily, with a minor output of roofing slate. Only one company produced in 1944, and the output of both electrical and roofing slate was substantially lower than in 1943.

New York-Vermont.—To maintain necessary confidential treatment of individual company figures, Maine has been included with Vermont in the accompanying table. The total value of slate products sold in New York, Vermont, and Maine was 5 percent more in 1944 than in 1943. Squares of roofing slate sold in Vermont in 1944 declined to less than one-fourth of the number sold in 1942, the latest year for which separate figures may be shown. There were only 11 operators in Vermont in 1944 compared with 26 in 1942. The superior endurance and artistic qualities of the Vermont and New York roofing slates should encourage their wide use in the postwar building era. Production in New York, which consisted chiefly of granules, was considerably higher than in 1943.

Peach Bottom district.—The slate quarries on the Maryland-Pennsylvania border near Cardiff, Md., and Delta, Pa., produced only granules and flour in 1944. Excellent-quality roofing slate is obtainable in this region, but production has been very small during recent years.

Lehigh district.—All the well-known slate products are made in Lehigh and Northampton Counties, Pa., which comprise the most productive slate area in the United States. As separate figures may not be shown for York County it is included with Northampton County in the accompanying table showing detailed figures for Pennsylvania.

The total value of all slate products sold in the Lehigh district in 1944 was lower than in 1943 by the small margin of less than 1 percent. Roofing-slate sales were 9 percent less in quantity and 5 percent in value than in 1943. The following mill-stock products declined in both quantity and value: Electrical (3 percent in quantity and 7 percent in value), structural and sanitary (11 percent in both quantity

and value), billiard-table tops (44 percent in quantity and 38 percent in value), and school slates (45 percent in quantity and 47 percent in value). Blackboards and bulletin boards gained 8 percent in quantity and 20 percent in value, whereas vaults and covers declined 10 percent in quantity but gained 6 percent in value. The value of miscellaneous products (largely granules and flour) gained 9 percent. The "hard-vein" slate of this area is used chiefly for roofing, whereas the "soft-vein" is well-adapted for making blackboards and other structural products in addition to roofing.

Slate sold by producers in Pennsylvania in 1944, by counties and uses

County	Oper- ators	Roofing slate		Mill stock					
		Squares (100 square feet)	Value	Electrica		Structural and sanitary		Vaults and covers	
				Square feet	Value	Square feet	Value	Square feet	Value
Lehigh.....	5	3, 850	\$40, 017	43, 590	\$18, 440	1, 010	\$664	(¹)	(¹)
Northampton and York ²	13	66, 370	574, 060	23, 940	8, 545	379, 170	142, 317	1341, 420	1101, 679
Total: 1944.....	18	70, 220	614, 077	67, 530	26, 985	380, 180	142, 981	341, 420	101, 679
1943.....	21	77, 270	648, 237	69, 890	29, 058	428, 300	161, 557	379, 920	95, 653

County	Mill stock—Continued						Other uses (value)	Total value
	Blackboards and bulletin boards		Billiard-table tops		School slates			
	Square feet	Value	Square feet	Value	Square feet	Value		
Lehigh.....	112, 770	\$21, 562			256, 280	\$3, 815		1 887, 498
Northampton and York ²	389, 960	99, 468	179, 800	\$61, 069			\$753, 260	1 1, 740, 398
Total: 1944.....	502, 730	121, 030	179, 800	61, 069	256, 280	6, 815	753, 260	1, 827, 896
1943.....	466, 160	100, 961	323, 620	98, 728	461, 850	12, 804	689, 927	1, 836, 925

¹ Small amount of slate for grave vaults and covers produced in Lehigh County included under Northampton and York Counties.

² York County produced granules and flour only.

Virginia.—Sales of roofing slate, principal product in Buckingham County, declined 25 percent in quantity and 24 percent in value in 1944 compared with 1943. Because of the small number of operators sales of granules and flour may not be shown.

Other districts.—Slate products, chiefly granules and flour, were produced in Montgomery County, Ark., near Glenwood; near Placerville, Eldorado County, Calif.; and in Bartow County, Ga., near Fair Mount.

POSTWAR OUTLOOK

The degree of prosperity attained by the slate industry in the years immediately following the war will depend chiefly on the volume of new residential construction. This type of building was at a very low level in 1944 and will so continue until the war emergency has passed. Rehabilitation of the slate industry is conditioned primarily on cessation of major hostilities. Even when the war emergency is over some time must elapse before a substantial increase in slate production may be expected. The length of this period will depend upon the promptness with which residential building is resumed after the close

of the war. Several months may elapse after the green light is flashed, permitting resumption of general building activity, before such bottlenecks as hardware and plumbing-fixture needs will be cleared.

A vast backlog of residential building exists. The F. W. Dodge Corporation reports a total of more than \$1,100,000,000 as the value of planned residential postwar construction; but early in 1945 most of it had not reached the design stage. The slate industry has the prospect of benefiting in a large way from this program. Unfortunately, however, that industry will experience considerable difficulty in weathering the unparalleled depression of the war years. Some quarries will be abandoned permanently because they cannot be dewatered and reconditioned profitably. Consequently, the industry may not be in a position to take full advantage of a broad expansion in market demands.

FOREIGN TRADE ¹

Because of Government restrictions, recent figures on imports and exports have not been published. However, these restrictions have been relaxed to the extent that detailed data for 1941 and 1942 may now appear.

Imports.—Imports of slate into the United States are very small. Their value for the 5 years 1938–42 is indicated in the following table.

Slate imported for consumption in the United States, 1938–42, by countries

Country	1938	1939	1940	1941	1942
Canada.....	\$543	\$570	.....	\$189	\$177
China.....	3	26	\$21	45	.....
Czechoslovakia.....	1,037	.....	.....	.....	.....
France.....	895	.....	.....	.....	.....
Hong Kong.....	59	4	.....	26	.....
Italy.....	994	356	324	.....	.....
Japan.....	68	61	175	7	.....
United Kingdom.....	3,089	.....	.....	1,381	.....
	6,688	1,017	520	1,648	177

Exports.—The following table lists the value of exports of slate products from 1938 to 1942, as reported to the Bureau of Mines by shippers.

Slate exported from the United States, 1938–42, by uses ¹

Use	1938	1939	1940	1941	1942
Roofing.....	\$5,070	\$5,244	\$5,547	\$4,211	(¹)
School slates.....	35,717	\$ 17,739	\$ 30,503	\$ 46,490	\$ 326,481
Electrical.....	1,239	1,726	4,721	4,644	6,163
Blackboards.....	10,400	8,448	4,088	5,206	6,112
Billiard tables.....	10,182	18,111	24,197	46,612	54,669
Structural ⁴	1,314	5,791	.....	.....	(¹)
Slate granules and flour.....	93,675	120,731	121,038	158,100	.....
Undistributed.....	.....	.....	.....	.....	146,794
	157,597	177,790	196,694	265,263	240,219

¹ Figures collected by Bureau of Mines from shippers of products named.

² Included under "Undistributed."

³ Includes slate used for pencils and educational toys.

⁴ Includes slate for floors and walkways.

⁵ Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce

SAND AND GRAVEL

By G. W. JOSEPHSON AND G. E. TUCKER

SUMMARY OUTLINE

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SUMMARY

In harmony with the general trend in construction activity, the output of sand and gravel declined to a prewar level in 1944.

Industrial sand rode the crest of war production to a new record; but building and paving materials, which constitute the bulk of the sand and gravel tonnage, were caught in a declining period following the height of war construction. Labor problems, decreasing tonnage, and shortage of supplies made production increasingly difficult. A few price increases were authorized by the Office of Price Administration, but on the average unit values were slightly lower than in 1943. Commercial operations produced over three quarters of the total tonnage as Government-and-contractor output declined to the lowest point since 1935.

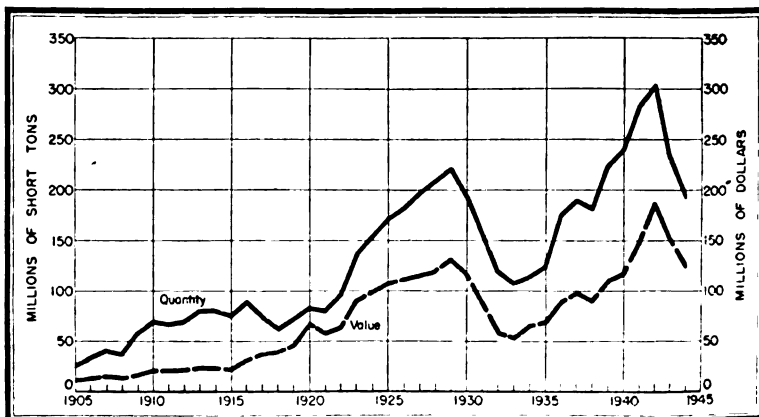


FIGURE 1.—Total production of sand and gravel in the United States, 1905-44.

POSTWAR PROSPECTS

Sand and gravel producers expect a large market after the war. If financial conditions are favorable, home and industrial building can reach major proportions. Road maintenance has been more or less neglected for several years. Networks of new highways and many new dams have their advocates. Although such projects have

many obvious advantages the whole program draws its strongest support from the fact that it can serve as a means of maintaining high employment. Some of the money has already been earmarked for specific purposes, but many financial obstacles remain to be overcome.

Sand and gravel sold or used by producers in the United States, 1943-44, by commercial and Government-and-contractor operations and by uses

	1943			1944			Percent of change in—	
	Short tons	Value		Short tons	Value		Ton- nage	Aver- age value
		Total	Average		Total	Average		
COMMERCIAL OPERATIONS								
Sand:								
Glass.....	3,971,931	\$7,376,566	\$1.86	4,443,031	\$8,227,502	\$1.85	+11.9	-0.5
Molding.....	8,924,654	12,093,670	1.36	8,983,075	11,752,360	1.31	+7	-3.7
Building.....	30,910,985	18,662,075	.60	26,356,834	16,154,889	.61	-14.7	+1.7
Paving.....	23,439,936	14,304,867	.61	16,886,764	10,319,762	.61	-28.0	.....
Grinding and polishing ¹	637,662	1,428,463	1.71	897,983	1,563,511	1.74	+7.2	+1.8
Fire or furnace.....	394,753	539,273	1.37	362,978	479,711	1.32	-8.0	-3.6
Engine.....	2,862,025	1,983,364	.69	2,852,648	1,993,119	.70	-7	+1.4
Filter.....	158,555	258,547	1.63	146,008	263,922	1.81	-7.9	+11.0
Railroad ballast ²	1,319,896	411,938	.31	1,211,894	381,489	.31	-8.2	.....
Other ³	1,461,977	1,180,190	.81	1,388,749	1,012,608	.73	-5.0	-9.9
Total commercial sand.....	74,282,371	58,238,953	.78	63,529,964	52,148,873	.82	-14.5	+5.1
Gravel:								
Building.....	31,121,915	24,395,097	.78	25,946,102	19,729,145	.76	-16.6	-2.6
Paving.....	49,050,490	35,769,203	.73	37,043,972	26,199,925	.71	-24.5	-2.7
Railroad ballast ⁴	19,407,356	8,022,006	.41	21,267,398	9,433,602	.44	+9.6	+7.3
Other ⁵	2,607,121	1,476,862	.57	2,845,645	1,284,632	.45	+9.1	-21.1
Total commercial gravel.....	102,186,882	69,663,168	.68	87,103,117	56,647,364	.65	-14.8	-4.4
Total commercial sand and gravel.....	176,469,256	127,902,121	.72	150,633,081	108,796,237	.72	-14.6	.....
GOVERNMENT-AND-CONTRACTOR OPERATIONS ⁶								
Sand:								
Building.....	3,187,000	1,757,000	.55	856,000	474,000	.55	-73.1	.....
Paving.....	4,584,000	2,267,000	.49	4,592,000	1,431,000	.31	+2	-36.7
Total Government-and-contractor sand.....	7,771,000	4,024,000	.52	5,448,000	1,905,000	.35	-29.9	-32.7
Gravel:								
Building.....	4,106,000	2,803,000	.68	2,663,000	1,626,000	.61	-35.1	-10.3
Paving.....	45,718,000	18,064,000	.40	36,039,000	12,837,000	.36	-21.2	-10.0
Total Government-and-contractor gravel.....	49,824,000	20,867,000	.42	38,702,000	14,463,000	.37	-22.3	-11.9
Total Government-and-contractor sand and gravel.....	57,595,000	24,891,000	.43	44,150,000	16,368,000	.37	-23.3	-14.0
COMMERCIAL AND GOVERNMENT-AND-CONTRACTOR OPERATIONS								
Sand.....	82,053,000	62,253,000	.76	68,978,000	54,054,000	.78	-15.9	+2.6
Gravel.....	152,011,000	90,530,000	.60	125,805,000	71,110,000	.57	-17.2	-5.0
Grand total.....	234,064,000	152,793,000	.65	194,783,000	125,164,000	.64	-16.8	-1.5

¹ Includes blast sand as follows—1943: 450,997 tons valued at \$1,138,003; 1944: 482,293 tons, \$1,228,744.

² Includes ballast sand produced by railroads for their own use as follows—1943: 28,032 tons valued at \$5,399; 1944: 40,486 tons, \$10,263.

³ Includes some sand used by railroads for fills and similar purposes as follows—1943: 170,372 tons valued at \$23,974; 1944: 226,965 tons, \$57,060.

⁴ Includes ballast gravel produced by railroads for their own use as follows—1943: 7,661,118 tons valued at \$1,967,362; 1944: 9,097,590 tons, \$2,896,111.

⁵ Includes some gravel used by railroads for fills and similar purposes as follows—1943: 1,176,243 tons valued at \$266,318; 1944: 1,605,789 tons, \$308,780.

⁶ Approximate figures for States, counties, municipalities, and other Government agencies directly or under lease.

Industrial sands have only remote prospects of greatly exceeding 1944 tonnages immediately after the war. Neither is there any likelihood of collapse of their markets. They serve the manufacturing industries and will reach whatever level of output industrial production attains.

PRODUCTION

In 1944 production of sand and gravel was about 17 percent lower than in 1943.

By comparison with the record of over 300,000,000 tons set in 1942, production in 1944 was not very impressive, but by prewar standards the total was respectable—higher than the production level in 1938. The decline was primarily in the output of building and paving materials. As a class the industrial sands attained a new record, and ballast tonnage was greater than in 1943. Because stocks of sand and gravel are comparatively small and constant, production virtually equals sales. The two terms are used interchangeably in this report

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States, 1940-44

Year	Sand		Gravel (including railroad ballast)		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	78,674,000	\$45,332,000	159,634,000	\$65,356,000	238,308,000	\$110,688,000
1941.....	103,835,000	62,152,000	184,880,000	85,055,000	288,715,000	147,207,000
1942.....	107,371,000	74,443,000	196,975,000	114,057,000	304,346,000	188,500,000
1943.....	82,053,000	62,263,000	152,011,000	90,530,000	234,064,000	152,793,000
1944.....	68,978,000	54,054,000	125,805,000	71,110,000	194,783,000	125,164,000

California was again the leading producing State, followed by Illinois, Michigan, and Ohio in that order. The ranks of the States producing over 10,000,000 tons had dwindled from 9 in 1942 to 4 in 1944. Details of output in 1944, by States and uses, are presented in the following tables:

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1944, by States

State	Short tons	Value	State	Short tons	Value
Alabama.....	2,019,272	\$1,172,969	New Hampshire.....	838,668	\$120,943
Alaska.....	712,496	409,269	New Jersey.....	1,414,374	5,081,861
Arizona.....	586,164	342,038	New Mexico.....	439,286	292,601
Arkansas.....	2,665,688	1,805,690	New York.....	7,049,583	4,308,390
California.....	24,228,499	15,171,652	North Carolina.....	2,535,601	1,405,917
Colorado.....	2,369,521	1,518,718	North Dakota.....	2,127,029	733,340
Connecticut.....	1,587,268	784,572	Ohio.....	10,327,012	8,866,549
Delaware.....	88,445	47,269	Oklahoma.....	1,364,604	746,207
Florida.....	1,335,569	1,180,299	Oregon.....	4,601,163	3,752,671
Georgia.....	569,908	416,871	Pennsylvania.....	6,919,406	7,265,943
Hawaii.....	(1)	(1)	Puerto Rico.....	(1)	(1)
Idaho.....	1,494,646	788,798	Rhode Island.....	352,905	287,112
Illinois.....	12,317,626	8,922,068	South Carolina.....	269,743	190,114
Indiana.....	6,885,125	3,985,239	South Dakota.....	2,501,431	956,178
Iowa.....	5,271,031	2,084,149	Tennessee.....	2,784,157	2,314,478
Kansas.....	2,786,088	1,602,778	Texas.....	9,307,531	6,424,132
Kentucky.....	1,502,096	991,072	Utah.....	2,468,535	1,736,102
Louisiana.....	2,646,789	2,101,274	Vermont.....	168,006	107,853
Maine.....	1,940,966	710,047	Virginia.....	3,247,670	3,328,645
Maryland.....	3,279,307	2,792,183	Washington.....	6,946,153	4,076,976
Massachusetts.....	2,825,533	1,697,619	West Virginia.....	2,677,752	3,624,179
Michigan.....	12,184,583	6,103,136	Wisconsin.....	8,634,769	4,128,944
Minnesota.....	9,704,152	2,106,804	Wyoming.....	1,460,663	720,381
Mississippi.....	1,802,479	877,370	Undistributed ¹	74,000	56,000
Missouri.....	3,183,176	2,370,261			
Montana.....	4,308,811	1,956,449			
Nebraska.....	3,894,983	1,896,777			
Nevada.....	983,074	713,302			
				194,783,000	125,164,000

¹ Output of Government-and-contractor operations included under "Undistributed."

² Includes items covered by "1."

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1944, by States and uses

[Commercial unless otherwise indicated]

State	Sand							
	Glass		Molding		Building			
					Commercial		Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			65,577	\$69,820	341,735	\$179,956	2,620	\$1,700
Alaska							2,599	3,145
Arizona					131,460	113,607		
Arkansas	(1)	(1)	(1)	(1)	234,229	153,703	147,305	111,915
California	222,770	\$607,110	93,528	289,067	4,742,443	2,856,602	173,479	75,005
Colorado			(1)	(1)	180,298	110,918	85,757	115,550
Connecticut	2,000	12,000	(1)	(1)	392,927	253,695	161,615	11,544
Delaware			3,762	1,782		350		
Florida	2,000	5,000			635,551	486,351		
Georgia	3,355	5,033	(1)	(1)	168,867	76,209	75	100
Hawaii							(1)	(1)
Idaho					73,748	77,472	1,163	285
Illinois	(1)	(1)	2,113,751	2,514,458	1,690,875	844,647		
Indiana			354,437	250,278	768,289	412,804		
Iowa			13,402	11,396	582,534	311,704		
Kansas			500	300	435,379	228,941	890	158
Kentucky			(1)	(1)	217,968	142,716	17,232	2,123
Louisiana			(1)	(1)	379,814	217,970		
Maine					33,230	18,582	150	10
Maryland	(1)	(1)			(1)	(1)		
Massachusetts			(1)	(1)	590,219	319,674	6,849	2,545
Michigan	(1)	(1)	(1)	(1)	1,077,851	481,552	4,816	1,060
Minnesota			18,502	21,107	684,369	304,114	2,786	1,017
Mississippi			3,858	3,429	81,729	41,463	12,000	800
Missouri	(1)	(1)	161,543	207,317	454,352	244,114		
Montana					120,102	82,713	484	478
Nebraska			1,357	480	202,448	103,245		
Nevada	(1)	(1)	15,727	37,381	7,695	8,550		
New Hampshire					5,000	2,500		
New Jersey	(1)	(1)	1,793,529	2,933,724	1,204,873	561,759		
New Mexico					(1)	(1)	1,652	1,709
New York	(1)	(1)	633,110	745,917	1,950,867	1,068,003	27	10
North Carolina					159,126	65,736		
North Dakota					31,528	23,837		
Ohio	(1)	(1)	944,634	1,784,432	1,666,516	1,208,469	204	96
Oklahoma	(1)	(1)	(1)	(1)	156,510	82,622	16,244	29,331
Oregon			(1)	(1)	298,194	251,141	2,538	10,170
Pennsylvania	(1)	(1)	454,959	853,318	1,441,814	1,268,878		
Puerto Rico			(1)	(1)	(1)	(1)	(1)	(1)
Rhode Island					(1)	(1)	4,050	3,000
South Carolina			5,013	6,266	45,256	26,505	210	345
South Dakota					472,486	449,151	26,734	4,255
Tennessee	(1)	(1)	155,735	317,288	1,322,560	806,817	4,734	4,185
Texas	(1)	(1)	(1)	(1)	115,298	60,602	4,190	1,891
Utah						(1)	449	35
Vermont					629,305	513,579	62,349	29,581
Virginia	(1)	(1)	18,421	9,017	572,164	360,567	73,860	54,721
Washington			15,000	20,000	156,672	153,285		
West Virginia	(1)	(1)	(1)	(1)	956,296	442,424	35,746	6,152
Wisconsin					18,082	13,089	210	74
Wyoming					927,825	744,448	2,000	2,000
Undistributed	4,212,906	7,598,359	2,116,710	1,675,563	26,356,834	16,154,889	856,000	474,000
	4,443,031	8,227,502	8,983,075	11,752,360				

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1944, by States and uses—Continued

State	Sand—Continued							
	Paving				Grinding and polishing ¹		Fire or furnace	
	Commercial		Government-and-contractor					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama.....	171, 201	\$64, 510	102, 924	\$30, 955	(1)	(1)	(1)	(1)
Alaska.....			87, 791	115, 140				
Arizona.....	39, 054	30, 811	5, 212	3, 671				
Arkansas.....	178, 065	118, 085			(1)	(1)		
California.....	2, 899, 993	1, 592, 077	1, 677, 720	496, 698	(1)	(1)		
Colorado.....	28, 590	14, 445	31, 898	8, 265	2, 232	\$2, 476		
Connecticut.....	89, 187	57, 001	195, 254	19, 098	(1)	(1)		
Delaware.....	14, 101	8, 461			3, 357	6, 714		
Florida.....	196, 861	113, 675	3, 300	400				
Georgia.....	169, 831	133, 152			15, 241	15, 426		
Hawaii.....	(1)	(1)						
Idaho.....	(1)	(1)	10, 021	2, 087				
Illinois.....	670, 589	356, 253	14, 689	6, 950	(1)	(1)	(1)	(1)
Indiana.....	759, 137	473, 968	129, 733	35, 756			(1)	(1)
Iowa.....	123, 528	60, 017	31, 650	5, 059	(1)	(1)		
Kansas.....	718, 345	443, 156	54, 990	7, 773	(1)	(1)	660	\$394
Kentucky.....	228, 365	209, 839						
Louisiana.....	262, 920	201, 780			500	250		
Maine.....	30, 759	16, 614	86, 803	27, 900	(1)	(1)		
Maryland.....	609, 596	478, 018	18, 642	788				
Massachusetts.....	561, 510	313, 213	93, 078	43, 399	(1)	(1)		
Michigan.....	801, 042	426, 845	95, 179	49, 338	(1)	(1)	250	112
Minnesota.....	223, 740	97, 720	42, 217	14, 101	1, 603	1, 509	103	103
Mississippi.....	445, 911	158, 800	6, 075	337	168	84		
Missouri.....	189, 505	105, 223	54, 505	31, 403	(1)	(1)	(1)	(1)
Montana.....	6, 510	6, 900	1, 319	1, 450				
Nebraska.....	193, 152	89, 357	7, 050	2, 684	3, 234	2, 174		
Nevada.....	(1)	(1)	1, 080	25				
New Hampshire.....			282, 210	29, 131				
New Jersey.....	363, 142	167, 946	(1)	(1)	88, 929	223, 102	(1)	(1)
New Mexico.....			5, 629	4, 503	(1)	(1)		
New York.....	1, 029, 762	518, 553	95, 358	21, 581	(1)	(1)	500	500
North Carolina.....	469, 501	179, 796	974, 649	203, 915	(1)	(1)		
North Dakota.....	(1)	(1)	11, 604	2, 901	(1)	(1)		
Ohio.....	1, 076, 622	702, 390	813	662	(1)	(1)	104, 556	232, 618
Oklahoma.....	175, 268	87, 026			9, 000	4, 500		
Oregon.....	336, 896	286, 826	49, 003	46, 113				
Pennsylvania.....	936, 576	802, 710			(1)	(1)	62, 775	92, 599
Puerto Rico.....			(1)	(1)				
Rhode Island.....	(1)	(1)	12, 312	5, 930				
South Carolina.....	(1)	(1)	7, 886	2, 983	(1)	(1)		
South Dakota.....	11, 527	8, 589	5, 173	3, 628				
Tennessee.....	264, 484	255, 635	1, 836	3, 060	(1)	(1)	(1)	(1)
Texas.....	1, 009, 326	693, 465	19, 283	12, 782	11, 007	21, 691		
Utah.....	99, 774	58, 975	7, 306	1, 108				
Vermont.....	(1)	(1)	3, 030	634	25, 718	9, 525		
Virginia.....	545, 138	388, 501	72, 450	38, 260	1, 000	500		
Washington.....	378, 059	186, 162	99, 039	70, 775	(1)	(1)		
West Virginia.....	240, 926	228, 624			(1)	(1)		
Wisconsin.....	128, 664	62, 109	123, 986	30, 208	47, 879	92, 870		
Wyoming.....			23, 212	20, 686				
Undistributed ²	209, 607	122, 535	46, 000	29, 000	688, 115	1, 182, 690	194, 134	153, 497
	16, 886, 764	10, 319, 762	4, 592, 000	1, 431, 000	897, 983	1, 563, 511	362, 978	479, 711

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1944, by States and uses—Continued

State	Sand—Continued							
	Engine		Filter		Railroad ballast ⁴		Other ⁵	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama.....	126, 479	\$44, 406					1, 368	\$789
Alaska.....								
Arizona.....	13, 403	9, 747					5, 942	1, 485
Arkansas.....	(1)	(1)	(1)	(1)				
California.....	(1)	(1)	(1)	(1)	28, 171	\$15, 721	57, 257	80, 332
Colorado.....	41, 821	42, 323	(1)	(1)	32, 826	18, 938	14, 995	2, 356
Connecticut.....			6, 918	\$3, 400	10, 323	8, 702	14, 808	7, 210
Delaware.....	63, 300	26, 800	329	740			3, 246	2, 597
Florida.....			(1)	(1)	9, 450	1, 890	(1)	(1)
Georgia.....	21, 551	9, 296			(1)	(1)	109, 162	103, 775
Hawaii.....								
Idaho.....								(1)
Illinois.....	188, 812	104, 967	(1)	(1)	(1)	(1)	118, 178	138, 589
Indiana.....	142, 778	60, 479			47, 347	16, 866	(1)	(1)
Iowa.....	50, 442	42, 521	(1)	(1)	(1)	(1)	23, 198	15, 400
Kansas.....	112, 331	70, 041	3, 317	5, 362	47, 588	14, 437	48, 381	19, 003
Kentucky.....	(1)	(1)			(1)	(1)		
Louisiana.....	21, 346	9, 503			(1)	(1)	3, 002	1, 415
Maine.....	(1)	(1)			(1)	(1)	7, 319	2, 690
Maryland.....	(1)	(1)						
Massachusetts.....	11, 000	2, 750	(1)	(1)			40, 704	10, 857
Michigan.....	6, 329	2, 215			133, 248	37, 492	35, 110	18, 055
Minnesota.....	31, 081	7, 254	664	2, 158	171, 949	37, 928	26, 309	5, 358
Mississippi.....	15, 948	5, 942					560	280
Missouri.....	58, 737	29, 705	1, 000	500	109, 010	28, 002	(1)	(1)
Montana.....					(1)	(1)	(1)	(1)
Nebraska.....	122, 578	49, 031	(1)	(1)	14, 370	5, 093	134, 326	27, 410
Nevada.....							(1)	(1)
New Hampshire.....							10, 000	2, 200
New Jersey.....	51, 610	67, 227	38, 713	65, 451			4, 649	7, 344
New Mexico.....	(1)	(1)						
New York.....	106, 967	62, 554	17, 599	8, 017	17, 364	7, 717	166, 897	73, 091
North Carolina.....	23, 496	19, 997	(1)	(1)	(1)	(1)	16, 288	3, 576
North Dakota.....					540	200	(1)	(1)
Ohio.....	113, 875	80, 295	(1)	(1)	(1)	(1)	81, 445	76, 596
Oklahoma.....	94, 591	48, 096	(1)	(1)			6, 799	1, 397
Oregon.....	(1)	(1)			14, 413	8, 570	327	322
Pennsylvania.....	373, 857	447, 635	7, 000	23, 940			140, 676	172, 148
Puerto Rico.....								
Rhode Island.....			(1)	(1)				
South Carolina.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota.....								
Tennessee.....	(1)	(1)	(1)	(1)			3, 408	3, 541
Texas.....	105, 864	38, 660	(1)	(1)	(1)	(1)	32, 223	7, 739
Utah.....	(1)	(1)	(1)	(1)			(1)	(1)
Vermont.....	3, 183	2, 546					1, 720	920
Virginia.....	98, 640	44, 388					(1)	(1)
Washington.....	(1)	(1)	(1)	(1)	8, 813	2, 935	62, 973	23, 035
West Virginia.....	357, 549	367, 571			(1)	(1)	4, 813	(1)
Wisconsin.....	(1)	(1)	(1)	(1)	49, 143	15, 303	10, 255	4, 141
Wyoming.....							4, 813	700
Undistributed ³	485, 080	297, 170	70, 468	154, 354	517, 339	161, 695	201, 331	198, 287
	2, 852, 648	1, 993, 119	146, 008	263, 922	1, 211, 894	381, 489	1, 388, 749	1, 012, 008

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1944, by States and uses—Continued

State	Gravel							
	Building				Paving			
	Commercial		Government-and-contractor		Commercial		Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama.....	579,641	\$442,646			291,784	\$231,061	208,164	\$20,856
Alaska.....			11,908	\$17,720			610,198	363,264
Arizona.....	77,627	67,740	135	75	55,668	53,330	161,490	32,142
Arkansas.....	314,388	263,270	245,831	204,585	255,338	164,685	352,687	184,650
California.....	5,614,419	3,888,271	467,853	197,317	5,413,776	3,734,022	1,739,011	806,761
Colorado.....	233,647	194,358	478,390	319,224	138,247	113,284	916,920	479,922
Connecticut.....	420,163	238,848			109,612	68,420	114,885	42,760
Delaware.....								
Florida.....	384,635	463,430			41,973	53,082		
Georgia.....			100	300				
Hawaii.....			(1)	(1)				
Idaho.....	106,696	105,566	23,523	8,616	305,832	238,245	642,719	243,234
Illinois.....	1,745,595	926,140	4,050	1,200	1,779,506	914,961	618,209	279,662
Indiana.....	772,846	544,537	5,964	426	2,085,151	1,363,512	350,121	133,377
Iowa.....	548,014	439,701	46,515	11,662	1,407,774	675,108	2,095,573	345,365
Kansas.....	61,490	42,510			639,189	466,467	649,946	287,847
Kentucky.....	134,579	121,371	103,685	54,076	162,784	155,446	396,465	147,400
Louisiana.....	860,644	729,029			717,197	718,492	44,727	9,411
Maine.....	136,851	121,661	675	105	138,488	55,707	1,356,463	397,746
Maryland.....	(1)	(1)			677,289	711,720	443,879	40,562
Massachusetts.....	451,658	368,518	675	500	552,600	288,467	899,994	236,511
Michigan.....	1,530,105	812,407	120,020	25,077	3,988,696	2,299,508	2,196,087	789,337
Minnesota.....	442,453	401,477	41,578	21,155	426,423	201,534	5,287,990	363,129
Mississippi.....	246,872	149,404	179,747	149,671	464,463	300,664	205,572	23,879
Missouri.....	374,783	221,302			694,996	419,266	331,328	129,131
Montana.....	76,623	63,737	751	909	113,010	112,000	1,707,876	1,013,776
Nebraska.....	860,500	412,592	2,100	1,350	1,957,651	1,018,134	277,493	126,814
Nevada.....	8,100	9,000	2,342	3,890	25,478	12,827	284,202	158,005
New Hampshire.....	7,000	8,750					534,458	78,362
New Jersey.....	287,980	293,453			230,691	145,579	(1)	(1)
New Mexico.....	46,484	33,115	12,869	13,021	(1)	(1)	58,922	24,658
New York.....	954,754	759,630	3,729	348	1,121,307	829,202	795,413	86,276
North Carolina.....	122,978	153,820			386,295	479,180	107,155	34,816
North Dakota.....	86,567	60,484	152,257	54,677	74,549	49,973	1,132,245	260,359
Ohio.....	1,139,275	870,685			2,855,467	2,103,917	321,702	68,415
Oklahoma.....	26,285	17,473	3,875	7,270	246,962	177,016	500,827	89,331
Oregon.....	399,642	344,494	29,833	22,203	1,463,670	1,265,000	1,194,195	1,069,941
Pennsylvania.....	1,428,257	1,222,965			1,004,923	786,417	72,016	19,123
Puerto Rico.....			(1)	(1)			(1)	(1)
Rhode Island.....	47,871	38,008	7,650	6,000	50,351	48,806	39,916	17,454
South Carolina.....	(1)	(1)			(1)	(1)	7,634	2,593
South Dakota.....	21,558	21,038	39,619	2,894	46,186	24,483	1,901,694	755,858
Tennessee.....	296,768	296,900	108,771	98,264	545,637	460,615	416,887	104,258
Texas.....	1,492,024	1,348,373			2,456,728	2,230,608	759,929	443,901
Utah.....	201,208	124,736	29,638	36,957	832,290	489,012	1,815,225	879,500
Vermont.....	9,996	12,066	1,890	270	52,076	37,719	40,131	25,526
Virginia.....	747,539	1,045,020	17,634	18,326	607,411	796,048	213,580	109,577
Washington.....	815,013	454,947	330,562	304,818	1,064,092	745,047	1,864,675	1,035,118
West Virginia.....	230,802	216,914	48,472	3,590	331,656	315,198	145,637	100,237
Wisconsin.....	908,726	540,217	108,534	29,269	1,333,483	685,110	2,994,074	1,122,928
Wyoming.....	17,543	16,096	30,220	11,184	47,319	49,898	267,360	175,968
Undistributed ^a	675,497	822,556	2,000	1,000	150,154	111,315	24,000	24,000
	25,946,102	19,729,145	2,663,000	1,626,000	37,043,972	26,199,925	36,039,000	12,887,000

See footnotes at end of table.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1944, by States and uses—Continued

State	Gravel—Continued				Sand and gravel			
	Railroad ballast ^a		Other ^b		Total commercial		Total Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama.....	86,895	\$49,159	(^c)	(^c)	1,705,564	\$1,119,458	313,708	\$53,511
Alaska.....							712,496	499,269
Arizona.....	65,730	11,276	30,543	\$18,154	419,327	306,150	166,837	35,888
Arkansas.....	747,267	300,861			1,919,665	1,304,549	746,023	501,150
California.....	787,591	218,064	170,582	67,739	20,170,436	13,595,881	4,058,063	1,575,771
Colorado.....	82,657	48,370	99,003	46,951	856,556	595,757	1,512,965	922,961
Connecticut.....	44,880	37,250	21,091	7,414	1,115,514	711,170	471,754	73,402
Delaware.....					88,445	47,269		
Florida.....	56,000	53,400	(^c)	(^c)	1,332,269	1,179,899	3,300	400
Georgia.....	(^c)	(^c)			569,733	416,471	175	400
Hawaii.....							(^c)	(^c)
Idaho.....	(^c)	(^c)	3,568	2,876	817,220	534,576	677,426	254,222
Illinois.....	1,788,760	710,166	109,856	33,413	11,680,678	8,634,256	636,948	287,812
Indiana.....	1,240,760	587,011	95,822	44,789	6,399,307	3,815,680	485,818	169,559
Iowa.....	330,802	121,483	4,237	14,483	3,097,293	1,722,063	2,173,738	362,086
Kansas.....	8,007	11,039	(^c)	(^c)	2,080,262	1,307,000	705,826	295,778
Kentucky.....					984,714	787,473	517,382	203,599
Louisiana.....	278,327	178,000	2,012	898	2,062,062	2,091,863	44,727	9,411
Maine.....	(^c)	(^c)	(^c)	(^c)	496,875	284,286	1,444,091	425,761
Maryland.....					2,816,786	2,750,833	462,521	41,350
Massachusetts.....	6,558	4,427	43,037	12,030	2,324,937	1,414,694	500,596	282,955
Michigan.....	430,658	229,224	26,627	8,640	9,768,481	5,238,324	2,416,102	864,512
Minnesota.....	2,128,350	584,914	173,945	42,226	4,329,581	1,707,402	5,374,571	399,402
Mississippi.....	139,107	42,335	469	282	1,399,085	702,683	403,394	174,687
Missouri.....	254,657	152,222	10,013	6,225	2,797,343	2,209,727	385,833	160,534
Montana.....	1,383,357	503,739	(^c)	(^c)	2,598,381	939,836	1,710,430	1,016,613
Nebraska.....	111,804	51,543	(^c)	(^c)	3,608,340	1,765,929	286,643	130,848
Nevada.....	623,154	319,312			755,450	551,382	227,624	161,920
New Hampshire.....					22,000	13,450	816,668	107,493
New Jersey.....	(^c)	(^c)	6,519	22,829	4,514,374	5,081,861	(^c)	(^c)
New Mexico.....	102,372	53,110			360,214	247,810	79,072	44,791
New York.....	(^c)	(^c)	152,398	124,040	6,155,056	4,200,175	894,527	108,215
North Carolina.....	140,299	133,126	(^c)	(^c)	1,453,797	1,167,686	1,081,804	238,231
North Dakota.....	548,689	261,960	76,984	10,540	8,390,923	415,403	1,296,106	317,993
Ohio.....	1,538,667	761,706	168,654	210,981	10,004,293	8,797,376	322,719	69,173
Oklahoma.....	158	76	(^c)	(^c)	843,658	670,275	620,946	75,932
Oregon.....	693,657	402,075	98,001	31,221	3,323,294	2,604,244	1,275,869	1,148,427
Pennsylvania.....	49,200	24,600	28,543	28,771	6,847,390	7,246,820	72,016	19,123
Puerto Rico.....							(^c)	(^c)
Rhode Island.....					288,977	254,728	63,928	32,384
South Carolina.....	(^c)	(^c)			254,323	184,548	15,420	5,566
South Dakota.....	398,224	99,800	27,071	6,774	554,835	193,455	1,946,596	762,723
Tennessee.....	370,204	196,749	31,532	24,679	2,229,929	2,104,651	554,226	209,827
Texas.....	1,962,393	903,507	38,600	54,452	8,523,585	6,293,294	783,946	180,868
Utah.....	143,829	73,906	(^c)	(^c)	1,122,516	816,646	1,356,419	919,456
Vermont.....	8,813	2,334	2,997	1,866	112,006	78,058	45,500	29,765
Virginia.....	140,766	236,873	27,325	20,357	2,881,657	3,135,901	366,013	192,744
Washington.....	1,310,175	689,101	314,174	103,187	4,578,117	2,611,544	2,368,036	1,465,432
West Virginia.....	(^c)	(^c)			2,483,643	3,520,352	194,109	103,827
Wisconsin.....	1,405,852	432,747	39,382	23,440	5,372,429	2,940,880	3,262,340	1,187,554
Wyoming.....	1,011,382	427,534	42,522	6,162	1,139,661	512,469	321,002	207,912
Undistributed ^d	847,497	520,693	999,538	310,213			74,000	56,000
	21,267,398	9,433,662	2,845,645	1,284,632	150,633,081	108,796,237	44,150,000	16,368,000

^a Included under "Undistributed."

^b Includes items entered as "i."

^c Includes 482,293 tons of blast sand valued at \$1,228,744.

^d Includes 40,486 tons of ballast sand valued at \$10,263, produced by railroads for their own use.

^e Includes 286,965 tons of sand valued at \$57,060, used by railroads for fills and similar purposes.

^f Includes 9,097,560 tons of ballast gravel valued at \$2,896,111, produced by railroads for their own use.

^g Includes 1,605,789 tons of gravel valued at \$308,780, used by railroads for fills and similar purposes.

Government-and-contractor production.—As shown in the accompanying chart, during the depression Government-and-contractor production of sand and gravel became a very large factor in the industry. When defense and war activities displaced peacetime public projects its tonnage began to decline, and this trend continued through 1944. Whereas in 1939 Government-and-contractor production of

sand and gravel constituted 48 percent of the total output, by 1944 it had shrunk to 23 percent. The contributions of municipalities and counties have been fairly well maintained, but in 1944 the States were only about half as active as before the war, and Federal organizations reported only about one-tenth as much as in 1939.

In 1944 States reported 42 percent of the total, counties 42, municipalities 3, and other agencies 13.

As compared with 56 percent in 1943, contractors furnished only 37 percent of the total tonnage in 1944. The average value of Government-and-contractor production was 6 cents lower.

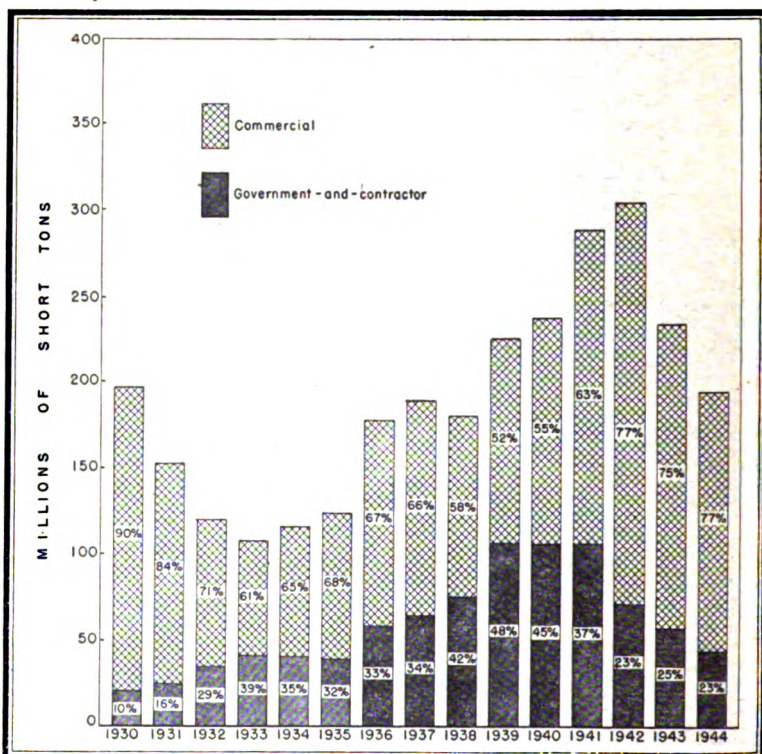


FIGURE 2.—Sand and gravel sold or used in the United States by commercial and Government-and-contractor producers, 1930-44.

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1940-44, by uses

Year	Sand				Gravel				Total Government and-contractor sand and gravel	
	Building		Paving		Building		Paving			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
		Dollars		Dollars		Dollars		Dollars		Dollars
1940.	5, 149, 000	2, 039, 000	9, 595, 000	2, 767, 000	9, 866, 000	4, 922, 000	82, 442, 000	22, 690, 000	107, 052, 000	32, 418, 000
1941.	5, 789, 000	1, 797, 000	12, 876, 000	4, 013, 000	8, 779, 000	3, 797, 000	79, 715, 000	22, 893, 000	107, 159, 000	32, 500, 000
1942.	3, 482, 000	2, 018, 000	5, 089, 000	2, 109, 000	8, 022, 000	3, 942, 000	54, 806, 000	21, 004, 000	71, 899, 000	29, 073, 000
1943.	3, 187, 000	1, 757, 000	4, 584, 000	2, 267, 000	4, 106, 000	2, 803, 000	45, 718, 000	18, 064, 000	57, 595, 000	24, 891, 000
1944.	856, 000	474, 000	4, 592, 000	1, 431, 000	2, 663, 000	1, 626, 000	36, 039, 000	12, 837, 000	44, 150, 000	16, 368, 000

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1941-44, by types of producers

Type of producer	1941		1942		1943		1944	
	Short tons	Average value per ton	Short tons	Average value per ton	Short tons	Average value per ton	Short tons	Average value per ton
Construction and maintenance crews.....	66,234,000	\$0.27	36,911,000	\$0.29	25,348,000	\$0.31	27,889,000	\$0.29
Contractors.....	40,925,000	.36	34,488,000	.53	32,247,000	.53	16,261,000	.50
	107,159,000	.30	71,399,000	.41	57,595,000	.43	44,150,000	.37
States.....	39,177,000	.26	23,334,000	.31	18,076,000	.42	18,775,000	.40
Counties.....	22,772,000	.20	18,841,000	.21	14,504,000	.27	18,421,000	.27
Municipalities.....	1,637,000	.29	1,397,000	.29	1,191,000	.32	1,227,000	.37
Other agencies.....	43,573,000	.40	27,827,000	.63	23,824,000	.54	5,727,000	.59
	107,159,000	.30	71,399,000	.41	57,595,000	.43	44,150,000	.37

METHOD OF TRANSPORTATION

Shortages of tires, gasoline, and truck replacements have given the railroads an opportunity to carry a higher percentage of the sand and gravel tonnage than before the war. On the other hand, shippers found that railroad cars were also at a premium, and even though total sales had declined deliveries were often delayed. Although railroads handled more than half of the output of commercial plants trucking is still the predominant method of transportation owing to its domination of Government-and-contractor operations. Waterways carry only a minor fraction of the national total, but in many localities their facilities are the most economical and convenient.

Sand and gravel sold or used by commercial producers in the United States, 1943-44, by methods of transportation¹

Method of transportation	1943		1944	
	Short tons	Percent of total reported	Short tons	Percent of total reported
Truck.....	67,475,351	42.4	58,210,087	42.4
Rail.....	77,700,913	48.8	68,809,663	50.1
Waterway.....	13,974,693	8.8	10,359,959	7.5
Total reported.....	159,150,957	100.0	137,469,709	100.0
Percent of total commercial production covered.....		90.0		91.0

¹ For practical purposes the entire output of Government-and-contractor operations commonly is moved by truck. Including Government-and-contractor production, sand and gravel moved as follows—1943: Truck 58 percent, rail 36 percent, and waterway 6 percent; 1944: Truck 56 percent, rail 38 percent, and waterway 6 percent.

DEGREE OF PREPARATION

A large proportion of the sand and gravel produced in commercial plants is screened or otherwise prepared to meet specifications. On the other hand, the output of Government-and-contractor operations has a high percentage of unprepared material direct from the deposit. Washing and screening are inexpensive processes, but processing of any kind adds considerably to the cost of low valued products. Consequently, as shown in the accompanying table, output from commercial plants has a higher average unit value than has that from Government-and-contractor operations. Of the total sand and gravel

production in 1944, 71 percent was classified as prepared—the same ratio as in 1943.

Sand and gravel (prepared or unprepared) sold or used by producers in the United States, 1943-44, by commercial and Government-and-contractor operations

	1943			1944		
	Quantity		Average value per ton	Quantity		Average value per ton
	Short tons	Percent		Short tons	Percent	
Commercial operations:						
Prepared.....	152,788,204	87	\$0.77	128,326,430	85	\$0.77
Unprepared.....	23,681,052	13	.43	22,306,651	15	.43
	176,469,256	100	.72	150,633,081	100	.72
Government-and-contractor operations:						
Prepared.....	12,963,000	23	.75	9,150,000	21	.62
Unprepared.....	44,632,000	77	.34	35,000,000	79	.31
	57,595,000	100	.43	44,150,000	100	.37
Grand total.....	234,064,000	-----	.65	194,783,000	-----	.64

SIZE OF PLANTS

Plant size has returned substantially to the prewar pattern. From 87,000 tons in 1942 the average output of commercial plants declined to 62,000 tons in 1944. The number producing over 500,000 tons dropped from 76 to 30, and they contributed only 17.1 percent of the total tonnage as compared with 29.2 percent in 1942. The 51.1 percent that sold less than 25,000 tons apiece furnished only 7.1 percent of the total tonnage. More than half the plants are small, but the bulk of the output comes from those making more than 100,000 tons annually. Details of output, by size groups, in 1943 and 1944 are given in the following table.

Comparison of number and output of commercial sand and gravel plants in the United States, 1943-44, by size groups¹

Size group, in short tons	1943				1944			
	Plants ²		Production		Plants ²		Production	
	Number	Percent of total	Short tons	Percent of total	Number	Percent of total	Short tons	Percent of total
Less than 25,000.....	1,119	48.6	9,429,000	5.6	1,148	51.1	9,931,000	7.1
25,000 and less than 50,000.....	393	17.1	13,924,000	8.3	415	18.5	15,001,000	10.7
50,000 and less than 100,000.....	323	14.0	22,717,000	13.6	297	13.2	21,080,000	15.1
100,000 and less than 200,000.....	258	11.2	35,934,000	21.5	225	10.0	31,157,000	22.3
200,000 and less than 300,000.....	104	4.5	24,944,000	14.9	77	3.4	18,466,000	13.2
300,000 and less than 400,000.....	34	1.5	11,936,000	7.1	37	1.7	12,553,000	9.0
400,000 and less than 500,000.....	31	1.4	14,047,000	8.4	17	.8	7,610,000	5.5
500,000 and less than 600,000.....	11	.5	6,057,000	3.6	10	.4	5,418,000	3.9
600,000 and less than 700,000.....	9	.4	5,897,000	3.5	7	.3	4,517,000	3.2
700,000 and less than 800,000.....	5	.2	3,768,000	2.3	4	.2	2,856,000	2.1
800,000 and less than 900,000.....	5	.2	4,589,000	2.7	4	.2	3,547,000	2.5
900,000 and less than 1,000,000.....			14,191,000	8.5	5	.2	7,466,000	5.4
1,000,000 and over.....	9	.4						
	2,301	100.0	167,433,000	100.0	2,246	100.0	139,602,000	100.0

¹ Plants operated by or for States, counties, municipalities and other Government agencies are not included; also not included are approximately 165 railroad plants with an output of 9,036,000 tons of sand and gravel in 1943 and 180 plants with an output of 11,031,000 tons in 1944.

² Includes a few companies operating more than 1 plant but not submitting separate returns for individual plants.

PRINCIPAL TRENDS

Sand and gravel for construction.—As shown in the accompanying chart, construction indexes continue to lead sand and gravel down, indicating a further decline in production for 1945. As the war progresses, construction reaches the doldrums, because the need for war construction declines and components for peacetime projects cannot be released in sufficient quantity. Little relief is expected until the end of the war.

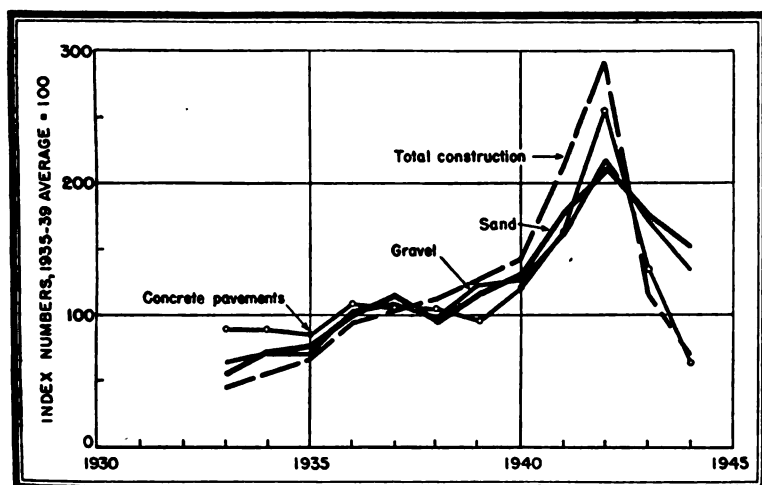


FIGURE 3.—Value of sand and gravel production compared with total construction (contract awards, value) and concrete pavements (contract awards, thousands of square yards) in the United States, 1933-44. Data on construction and concrete pavements from Bureau of Foreign and Domestic Commerce.

Industrial sands.—Serving the manufacturing rather than the construction industries, the industrial sands fared very well in 1944. Metal working was near capacity, consumption of glass sand increased substantially, and, although the tonnage of a few types declined somewhat, the output of industrial sands as a class attained a new record. Production of these sands is expected to continue at a high rate until the end of the war and possibly thereafter. Figure 4 shows the quantities of the various types of industrial sands produced during the past 29 years.

EMPLOYMENT AND PRODUCTIVITY

Commercial sand and gravel producers had difficulty in finding enough manpower to supply even the depleted demand. Total employment dropped to about 22,000 and on the average the men worked 9 hours per day. Considering the labor turn-over and decline in sales, productivity has been well-sustained. Although not as high as in 1941 and 1942, output per man-hour in 1944 compared favorably with prewar figures. The reports of operators who produced four-fifths of the total commercial tonnage are summarized in the accompanying tables.

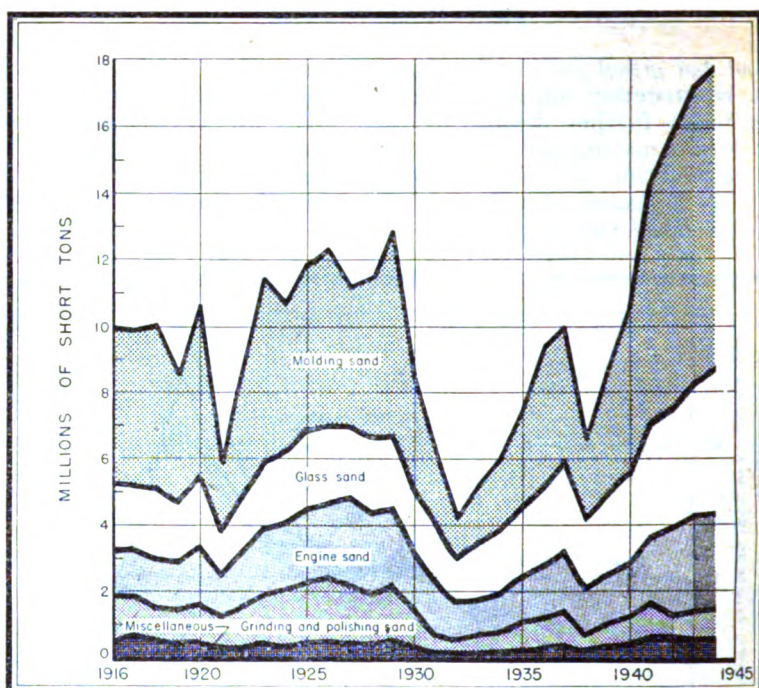


FIGURE 4.—Production of industrial sands in the United States, 1916-44.

*Employment in the commercial sand and gravel industry, sand and gravel produced at plants included in the study, and average output per man in the United States, 1938-44*¹

Year	Employment					Production (short tons)			Percent of commercial industry represented
	Average number of men	Time employed				Commercial sand and gravel	Average per man		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1938.....	14,971	201	3,001,796	8.5	25,578,807	81,742,896	27.2	3.2	81.1
1939.....	15,617	214	3,335,321	8.4	28,054,960	96,755,364	29.0	3.5	81.7
1940.....	16,595	217	3,596,886	8.4	30,263,744	101,143,305	28.1	3.3	79.6
1941.....	19,909	228	4,530,488	8.6	38,978,128	144,594,925	31.9	3.7	78.7
1942.....	25,061	227	5,679,695	8.9	50,694,303	183,255,772	32.3	3.6	78.3
1943.....	20,308	234	4,743,721	8.9	42,041,878	138,113,786	29.1	3.3	78.3
1944.....	17,777	228	4,055,192	9.0	36,584,540	120,968,395	29.8	3.3	80.3

¹ Excludes plants operated by or directly for States, counties, municipalities, and other Government agencies.

Employment in the commercial sand and gravel industry, sand and gravel produced at plants included in the study, and average output per man in the United States, 1943-44, by regions¹

Region	Employment					Production (short tons)			Per- cent of com- mer- cial indus- try repre- sented
	Average number of men	Time employed			Commercial sand and gravel	Average per man			
		Average number of days	Total man- shifts	Man-hours Average per man per day		Total	Per shift	Per hour	
1943									
Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, and Con- necticut.....	725	185	133,008	8.8	1,171,836	4,213,797	31.5	3.6	81.6
New York.....	984	202	198,590	8.4	1,666,767	6,405,240	32.3	3.8	86.8
Pennsylvania, New Jersey, and Delaware.....	2,352	260	610,543	8.9	5,444,410	14,097,698	23.1	2.6	98.1
West Virginia, Virginia, Maryland, and District of Columbia.....	1,538	282	433,638	9.2	3,970,632	7,843,459	18.1	2.0	71.1
South Carolina, Georgia, Alabama, Florida, and Mississippi.....	1,065	265	282,286	9.0	2,543,284	6,817,546	24.2	2.7	82.3
North Carolina, Kentucky, and Tennessee.....	958	262	250,891	9.0	2,250,638	5,335,386	21.3	2.4	87.3
Arkansas, Louisiana, and Texas.....	1,740	260	451,658	9.4	4,252,485	9,968,438	22.1	2.3	59.3
Ohio.....	1,452	247	358,013	8.5	3,058,594	8,890,501	24.8	2.9	73.5
Illinois and Indiana.....	1,949	231	450,610	8.7	3,931,531	17,717,819	39.3	4.5	85.6
Michigan and Wisconsin.....	1,385	198	274,037	9.1	2,483,466	10,747,551	39.2	4.3	76.1
North Dakota, South Da- kota, and Minnesota.....	500	126	62,840	8.8	555,554	2,236,880	35.6	4.0	38.7
Nebraska and Iowa.....	840	181	152,236	9.7	1,479,795	5,937,115	39.0	4.0	81.4
Kansas, Missouri, and Okla- homa.....	1,047	247	258,094	8.6	2,223,707	6,611,080	25.6	3.0	93.6
Wyoming, Colorado, New Mexico, Utah, and Ariz- ona.....	526	212	111,577	8.3	928,886	3,199,030	28.7	3.4	65.2
California and Nevada.....	1,751	269	471,562	8.4	3,944,318	18,620,544	39.5	4.7	88.3
Montana, Washington, Ore- gon, and Idaho.....	1,496	163	243,229	8.8	2,135,975	9,481,702	39.0	4.4	66.4
Total United States..	20,308	234	4,743,721	8.9	42,041,878	138,113,786	29.1	3.3	78.3
1944									
Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, and Con- necticut.....	579	184	106,349	8.7	926,994	3,504,811	33.0	3.8	80.2
New York.....	820	201	164,812	8.4	1,383,794	5,068,335	30.8	3.7	82.3
Pennsylvania, New Jersey, and Delaware.....	2,149	255	547,443	8.8	4,792,563	11,238,735	20.5	2.3	98.2
West Virginia, Virginia, Maryland, and District of Columbia.....	1,249	270	337,827	9.2	3,099,575	6,091,241	18.0	2.0	74.4
South Carolina, Georgia, Alabama, Florida, and Mississippi.....	764	258	197,150	8.8	1,740,099	4,539,155	23.0	2.6	86.3
North Carolina, Kentucky, and Tennessee.....	907	258	234,342	9.2	2,150,584	4,318,487	18.4	2.0	92.5
Arkansas, Louisiana, and Texas.....	1,711	246	420,664	9.6	4,019,899	9,707,085	23.1	2.4	74.4
Ohio.....	1,721	212	365,359	8.6	3,125,603	8,591,305	23.5	2.7	85.9
Illinois and Indiana.....	1,600	213	340,005	10.4	3,519,237	14,835,695	43.6	4.2	82.1
Michigan and Wisconsin.....	1,512	189	286,358	9.1	2,609,905	13,169,893	46.0	5.0	87.0
North Dakota, South Da- kota, and Minnesota.....	305	159	48,423	8.9	431,616	2,177,281	45.0	5.0	38.1
Nebraska and Iowa.....	765	183	139,836	10.0	1,396,950	5,400,907	38.6	3.9	80.5
Kansas, Missouri, and Okla- homa.....	821	242	198,685	8.8	1,750,769	5,231,482	26.3	3.0	91.4

See footnote at end of table.

*Employment in the commercial sand and gravel industry, sand and gravel produced at plants included in the study, and average output per man in the United States, 1943-44, by regions*¹—Continued

Region	Employment					Production (short tons)			Per- cent of com- mer- cial indus- try repre- sented
	Average num- ber of men	Time employed				Commer- cial sand and gravel	Average per man		
		Average num- ber of days	Total man- shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1944—Continued									
Wyoming, Colorado, New Mexico, Utah, and Arizona.....	374	187	70,028	8.4	587,647	2,403,181	34.3	4.1	61.8
California and Nevada.....	1,654	261	431,618	8.4	3,644,137	18,729,742	43.4	5.1	89.5
Montana, Washington, Oregon, and Idaho.....	846	197	166,313	8.4	1,405,138	5,961,060	35.8	4.2	52.7
Total United States..	17,777	228	4,055,192	9.0	36,584,540	120,968,395	29.8	3.3	80.3

¹ Excludes plants operated by or directly for States, counties, municipalities, and other Government agencies.

PRICES

After advancing continually since 1940 the average value of sand and gravel declined slightly in 1944. Details of valuation are shown in the summary table at the beginning of this chapter.

Sand and gravel prices were controlled by the provisions of Maximum Price Regulation 188. After demonstrating the essentiality of their production and the need for relief, operators in Los Angeles, Miami, St. Louis, and a few other areas were authorized by the Office of Price Administration to raise prices. However, no general price increases were authorized, and competition for a declining volume of business also tended to control and in some cases reduce prices.

NEW DEVELOPMENTS

The practice of placing a carefully vented granular subbase course under all types of pavement to provide drainage has been very successful in preventing rupture from freezing or pumping, and it is being adopted more widely.¹

Producers are concerned over the trend toward requirement of higher percentages passing 50- and 100-mesh in specifications of concrete aggregates. In one area only 50 percent of the plants had enough fines in their deposits to meet proposed specification changes that would have required 10 to 30 percent minus 50-mesh and 2 to 10 percent minus 100-mesh.² To meet the new conditions, some companies are turning to crushing, and some are admixing fines obtained from other locations. Many companies that have ample fines in their pits find that their washing systems must be modified to retain the proper quantity. As entrained air acts somewhat like a fine aggregate it is possible that in the future the use of air-entraining compounds will reduce the need for higher proportions of mineral fines.

¹ Pit and Quarry, vol. 36, No. 8, February 1944, p. 57.

² Rock Products, vol. 47, No. 9, September 1944, p. 74.

FOREIGN TRADE.

Compared with the quantity of sand and gravel used in the United States, foreign sales and purchases are negligible. However, by most standards the tonnage is considerable.

Owing to wartime restrictions on publication of foreign trade statistics, the Sand and Gravel chapter has not contained current figures since 1941. As these limitations have now been liberalized the accompanying table shows the record of imports during the past 10 years. Before the war Belgium had a market for glass sand on the West coast, but in 1940 this movement was interrupted. In 1944 over 99 percent of all imports came from Canada.

Exports of sand and gravel have not been separately classified by the United States Department of Commerce since 1939, but before then they commonly ranged between 25,000 and 100,000 tons a year. A summary of exports is given in Minerals Yearbook, 1942.

Sand gravel imported for consumption in the United States, 1935-44, by classes

Year	Sand				Gravel		Total	
	Glass sand ¹		Other sand ²					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935.....	44,291	\$94,966	62,225	\$51,658	63,189	\$15,851	169,705	\$162,475
1936.....	52,944	117,706	124,013	62,193	201,398	38,142	378,355	218,041
1937.....	51,090	79,112	319,134	134,430	163,406	36,193	533,630	249,735
1938.....	33,889	68,315	611,468	157,992	55,619	22,902	700,976	249,209
1939.....	23,690	33,604	192,106	79,272	60,147	8,399	275,943	121,275
1940.....	4,337	8,722	264,170	90,350	175,558	25,686	444,065	124,758
1941.....			263,389	105,088	164,175	26,132	427,564	131,220
1942.....	(³)	5	408,825	297,122	146,116	60,389	554,941	357,516
1943.....	18	363	296,262	206,145	86,924	63,381	383,204	269,886
1944.....	15	181	209,255	129,632	67,929	31,208	277,199	161,021

¹ Classification reads "Sand containing 95 percent silica and not more than 0.6 percent oxide of iron and suitable for manufacture of glass."

² Classification reads "Sand, n. s. p. f."

³ Less than 1 ton.

BLAST-FURNACE SLAG

In 1944 output of commercialized blast-furnace slag totaled 12,405,992 short tons, 25 percent less than the 16,507,607 tons reported in 1943. Sales of air-cooled slag declined 24 percent, and the average value per ton of screened increased 1 cent, whereas unscreened was 1 cent lower than in 1943. These statistics are based on a canvass, conducted by the National Slag Association, of the 32 companies that prepare blast-furnace slag for commercial use.

Practically all of the commercial production is east of the Mississippi River, chiefly at steel centers located in Ohio, Alabama, Pennsylvania, and Illinois. Shipments, however, are made into all States east of the Mississippi except some of the New England States outside the economic range of sources of supply. Shipments of slag are made by railroad, truck, and waterway. The accompanying tabulations show the pattern of distribution during the past 4 years.

The average shipping range of blast-furnace slag in 1944 was 61 miles by rail, 15 by truck, and 125 by waterway. In most instances shipments did not exceed 100 miles by railroad, 30 by truck, and 250 by waterway.

*Shipments of commercial slag in the United States, 1941-44, by methods of transportation*¹

[Percent of total]

Method of transportation	1941	1942	1943	1944
Rail.....	55	52	56	55
Truck.....	43	47	44	44
Waterway.....	2	1	(?)	(?)

¹ National Slag Association.² Less than 0.5 percent.

Details of the tonnage and values of slag consumed in the various uses are shown on an accompanying table. With the decline in construction activity since 1942, consumption in buildings and roads has fallen. On the other hand, railroads have faced a huge track-maintenance problem that could not be ignored. Insufficient labor has been a limiting factor, but means have been found to place nearly 3,000,000 tons of slag ballast annually during the past 3 years.

The quantities consumed in the manufacture of mineral wool and lightweight aggregates have increased since 1942, and promotion of agricultural slag has met some success. Finely ground slag is said to have value as a liming material and as a source of essential minor fertilizer compounds.

When slag is tapped from the blast furnace some iron also escapes through the slag notch. By hand picking and magnetic pulleys this metal is separated during crushing and screening at the slag plant; producers reported that 114,790 tons of iron were recovered and returned to the furnaces in 1944. The yield was about 1.2 percent or approximately 24 pounds of iron per ton of slag processed.

Not including those assigned to administrative, office, and sales activities 1,400 plant and yard employees were engaged in the production of commercial slag in 1944.

*Air-cooled blast-furnace slag sold or used by producers in the United States, 1943-44, by States*¹

	1943			1944		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Alabama.....	4,379,490	29.0	\$3,066,708	3,089,075	26.8	\$2,152,315
Ohio.....	3,722,825	24.7	3,284,040	2,920,145	25.4	2,764,467
Pennsylvania.....	2,342,858	15.5	2,204,186	1,426,247	12.4	1,466,322
Other States ¹	4,656,248	30.8	3,699,756	4,071,448	35.4	3,180,613
	15,101,421	100.0	12,254,690	11,506,915	100.0	9,563,717

¹ National Slag Association.² Illinois, New York, Maryland, Michigan, West Virginia, Kentucky, Colorado, Tennessee, and Massachusetts.

Blast-furnace slag sold or used by producers in the United States in 1944, by uses¹

Use	Air-cooled						Granulated						Lightweight	
	Screened			Unscreened			Short tons	Value		Short tons	Value			
	Short tons	Value		Short tons	Value			Total	Average per ton		Total	Average per ton		
		Total	Average per ton		Total	Average per ton								
Concrete pavements and structures	1,032,699	\$99,788	\$0.87	1,257	\$943	\$0.75	470,413	\$73,923	\$0.16					
Roads other than concrete	6,196,737	4,877,620	.94	136,402	41,241	.30								
Railroad ballast	2,911,634	2,046,934	.70	272,840	105,052	.39								
Airport runways	320,905	318,548	.99											
Mineral wool	307,635	294,481	.96											
Roofing slag	186,313	251,157	1.35											
Sewage trickle filter	36,777	46,996	1.28											
Agricultural slag	74,773	75,907	1.02											
Cement manufacture							27,704	21,439	.77					
Concrete products	9,916	65,687	.67				233,438	37,606	.16					
Other uses	565,194	383,139	.68	365,803	156,224	.43	1,700	340	.20	163,822	\$232,508	\$1.40		
Total: 1944	10,730,613	9,260,257	.86	776,302	303,460	.39	733,255	133,308	.18	163,822	232,508	1.40		
1943	13,736,642	11,714,225	.85	1,364,779	540,465	.40	1,329,215	319,421	.24	76,971	112,817	1.47		
1942	13,591,896	11,832,670	.87	2,073,611	884,178	.43	3,467,211	587,064	.17					
1941	12,372,218	10,434,187	.84	797,363	390,082	.49	1,508,685	239,833	.16					
1940	8,132,396	7,015,616	.86	1,230,822	507,288	.41	939,814	257,737	.26					
1939	7,108,061	5,870,582	.83	812,220	361,554	.45	1,188,094	122,017	.10					
1938	6,118,505	5,000,668	.92	1,202,754	507,224	.47	656,907	78,723	.12					

¹ National Slag Association.

GYPSUM

By CHARLES L. HARNESS AND M. G. DOWNE

SUMMARY OUTLINE

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SUMMARY

Production of crude gypsum in 1944—3,761,234 short tons—was 3 percent less than output in 1943 and 8 percent less than the average annual output during 1939–42. The decrease reflected the continuing impediments to construction. Calcined gypsum output was 8 percent less in 1944 than in 1943 and 28 percent less than the average annual production for 1939–42. Sales of uncalcined gypsum were 14 percent lower in 1944 than in 1943 and 9 percent lower than during the 1939–42 period.

Although public and private construction dropped 54 percent in 1944 as compared with 1943 (according to the United States Department of Commerce), shifts in the gypsum use pattern and substitution of gypsum board for scarce 1-inch lumber enabled the gypsum products industry as a whole to operate at near 1943 levels. The decline in construction did not materially affect sales of base plasters and gypsum lath. Demand for these items has been maintained in the last 2 or 3 years only at the volume necessary for repairs and a small amount of permissive construction and may be expected to remain at this level until general restrictions are removed from regular home building. Sales of lath and of base plaster in 1944 were about one-third of prewar volumes. Despite construction curtailments, wall-board sales were well-maintained in 1944 and indeed were considerably higher than prewar output, owing to substitution in construction outlets formerly dominated by 1-inch soft lumber. Expanding requirements for pattern-making and molds in machine shops and foundries maintained industrial sales of calcined gypsum at a high figure and partly offset declines in pottery and dental and orthopedic plasters. A 32-percent decline in the production of portland cement in 1944 caused an almost identical drop in sales of uncalcined gypsum for cement retarder. Curtailment of this market was partly offset by increased sales of agricultural gypsum.

War Production Board Conservation Order L-41 has restricted all types of construction since April 1942, and amendments during 1944

further tightened farm construction. Price control of gypsum products was continued under Maximum Price Regulation 188 of the Office of Price Administration, based on March 1942 levels. To help relieve a shortage of gypsum board in Arizona, California, Oregon, and Washington for use in Government projects, the agency since September 18, 1943, has permitted dealers in the States named to buy gypsum wallboard, lath, and sheathing from mills as far east as Ohio at mill price plus added freight. (Gypsum board is ordinarily sold on a delivered basis.) This provision, extended several times since its inception, expired January 1, 1945.

Imports of crude gypsum, nearly all from Nova Scotia and New Brunswick, Canada, were of the same order as in 1942 and 1943. Receipts in 1944 were about one-fourth of 1941 imports. Very little shipping space has been available.

Board plants operated at 67 percent capacity in 1944 compared with 78 percent in 1943 and 82 percent in the last four months of 1942.

Salient statistics of the gypsum industry in the United States, 1940-44

	1940	1941	1942	1943	1944
Active establishments ¹	91	93	² 90	85	77
Crude gypsum ³ —					
Mined.....short tons..	3,699,015	4,788,534	4,697,568	3,877,541	3,781,234
Imported.....do.....	1,405,210	1,847,957	394,460	231,323	342,462
Apparent supply.....do.....	5,104,225	6,136,491	5,092,028	4,108,864	4,103,696
Calculated gypsum produced: ⁴					
Short tons.....	3,307,709	3,980,567	3,045,082	2,557,730	2,363,143
Value.....	\$17,254,667	\$19,746,914	\$16,403,068	\$14,751,587	\$13,841,399
Gypsum products sold: ⁴					
Uncalcined uses:					
Short tons.....	929,119	1,320,713	1,514,913	1,233,727	1,056,276
Value.....	\$2,250,857	\$3,139,958	\$3,533,607	\$3,114,789	\$2,953,564
Industrial uses:					
Short tons.....	123,643	151,960	142,705	163,500	200,473
Value.....	\$1,532,738	\$1,885,313	\$1,840,927	\$2,258,981	\$2,550,649
Building uses:					
Value.....	\$49,700,049	\$64,734,171	\$57,796,210	\$53,722,762	\$50,196,006
Total value.....	\$53,492,644	\$69,758,442	\$63,170,744	\$59,096,532	\$55,700,219
Gypsum and gypsum products—					
Imported for consumption.....	\$1,429,289	\$1,282,140	\$508,321	\$304,154	\$393,033
Exported.....	\$264,128	\$529,574	\$977,863	\$293,720	\$498,189

¹ Each mine, plant, or combination mine and plant is counted as 1 establishment

² Revised figure.

³ Excludes byproduct gypsum.

⁴ Made from domestic, imported, and byproduct crude gypsum.

Gypsum products for export are normally sold by plants situated in eastern metropolitan centers, on a delivered price basis derived from the f. o. b. plant price at the nearest metropolitan mill plus an average trucking or shipping charge within the delivered area. The shortage of crude gypsum in the East has curtailed the amount of board available for Lend-Lease, and to draw on production farther west, the Office of Price Administration in Amendment 70 to Order A-1 under Maximum Price Regulation 188, February 15, 1945, permitted producers in eight specified States to add actual transportation costs to their f. o. b. plant ceiling prices for wallboard, lath, sheathing, and laminated gypsum products destined for export from Atlantic ports on Government or Lend-Lease orders.

Gypsum bagging was standardized to 2-, 5-, 10-, 25-, 50- and 100-pound bags by the War Production Board in Limitation Order L-279. As amended August 8, 1944, the order limits the use of bags to specified agricultural products, chemicals, and building materials, including gypsum plaster.

Court trial of the civil action by the United States Department of Justice against 7 gypsum companies and officials on charges of violating the Sherman Antitrust Act opened November 19, 1943, and was decided in 1944 in favor of the defendants. The Government urged that the licensing agreements of the U. S. Gypsum Co. with other members of the industry were beyond the scope of the monopoly of

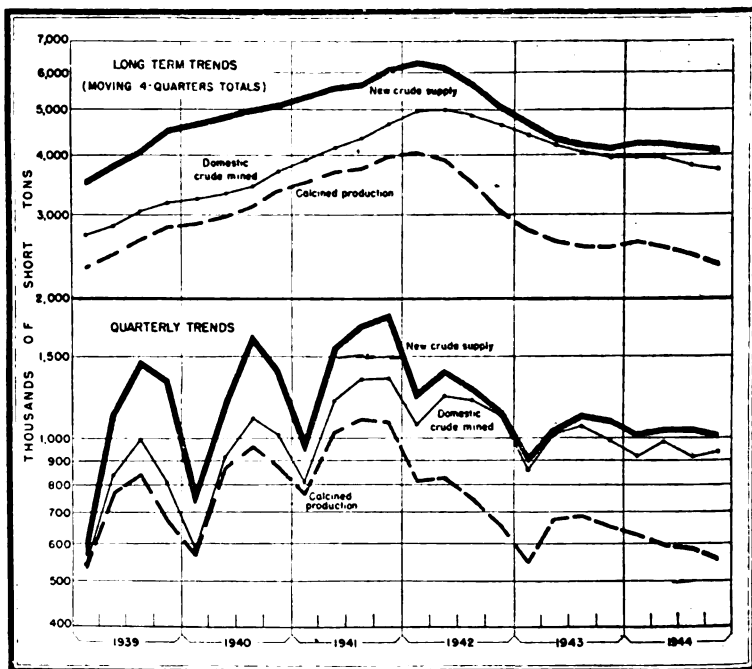


FIGURE 1.—Trends of new crude supply, domestic crude mined, and production of calcined gypsum, 1940-44, by quarters.

the patents licensed—particularly the Roos foam board patents—and asked that the patents be voided and the licenses dissolved. The court refused to do either.¹

The labor shortage in the industry was more severe than in 1943, when the War Manpower Commission certified the mining of gypsum and the production of gypsum boards to the list of activities essential to the war. According to the United States Department of Labor, 4,000 persons were employed in gypsum-product plants in February 1945 compared with 4,600 in February 1944 and 4,300 in February 1943. Average monthly employment in the gypsum products industry in 1944 was 84.0 percent of employment in 1939 compared with 92.0 percent in 1943. Overtime was considerable in 1944, as indicated by an average monthly wage-earner pay-roll index of 146.4 compared with 100 in 1939.

¹*United States v. U. S. Gypsum*, 53 Fed. Sup. 889 (Dist. Ct. Dist. Col., 1943).

POSTWAR OUTLOOK

A high level of activity in the gypsum industry is indicated for the postwar era. Building curtailment during the war has shelved a large volume of construction projects, both public and private, according to surveys made by various fact-finding agencies. Gypsum products doubtless will be used in the same capacity as in prewar years, except that gypsum board may find a wider application in farm construction than formerly. The industrial plaster group probably will continue at high levels both before and after reconversion. The new techniques developed with plaster models, patterns, and castings in the airplane industry may be utilized in retooling automobile and other mass-production plants. Renaissance of the auto industry also will mean expanded sales of plasters used to bed auto windshields and windows during polishing.

DOMESTIC PRODUCTION

Mine output of crude gypsum was 3 percent less than in 1943. Production declined in Iowa, New York, Texas, and other States but increased in California, Michigan, and Nevada. Active operations totaled 49, comprising 22 underground mines, 19 open quarries, and 8 mine-quarry combinations. The average mill value of run-of-mine gypsum was \$1.72 a short ton, an advance of \$0.18 over 1943

Crude gypsum mined in the United States, 1942-44, by States

State	1942			1943			1944		
	Active mines	Short tons	Value	Active mines	Short tons	Value	Active mines	Short tons	Value
California.....	9	426,670	\$662,181	6	455,580	\$622,575	6	502,629	\$799,882
Iowa.....	7	514,587	688,211	6	418,092	595,602	5	398,143	655,392
Michigan.....	6	891,180	1,286,242	6	538,602	737,719	4	552,672	891,965
Nevada.....	5	330,333	540,579	4	347,961	702,906	3	392,748	683,107
New York.....	19	1,012,987	1,605,530	9	713,961	1,229,796	7	594,067	1,128,821
Oklahoma.....	3	243,545	321,652	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Texas.....	6	414,196	496,609	7	394,841	519,541	7	344,936	489,638
Utah.....	4	48,574	60,259	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Other States.....	14	815,496	1,149,857	18	1,008,504	1,551,476	17	976,039	1,791,962
	¹ 63	4,697,568	6,811,180	56	3,877,541	5,959,615	49	3,761,234	6,450,767

¹ Revised figure.

² Included under "Other States."

³ By groups of States as follows—1942: Arizona (1), Arkansas (1), and Kansas (2)—142,731 tons valued at \$170,403; Colorado (2), Montana (2), South Dakota (1), and Wyoming (1)—135,588 tons, \$202,612; Ohio (2) and Virginia (2)—537,177 tons, \$776,842. 1943: Arkansas (1), Kansas (2), and Oklahoma (2)—371,893 tons, \$501,203; Colorado (3), Montana (2), South Dakota (1), Utah (2), and Wyoming (1)—166,547 tons, \$235,628; Ohio (2) and Virginia (2)—470,064 tons, \$814,645. 1944: Arkansas (1), Kansas (2), and Oklahoma (2)—295,604 tons, \$472,789; Colorado (2), Montana (2), South Dakota (1), Utah (2) and Wyoming (1)—165,360 tons, \$296,033; Ohio (2) and Virginia (2)—515,075 tons, \$1,023,140.

CALCINED PRODUCTION AND PROCESSING EQUIPMENT

The calcined production in 1944 was obtained from 47 active plants distributed through 20 States. Active calcining equipment in these plants comprised 190 units. The average mill value of calcined gypsum, which is a "transfer value" assigned by producers, increased 9 cents over 1943 to \$5.86 in 1944.

Calcined gypsum produced in the United States, 1943-44, by districts

District	1943		1944	
	Short tons	Value	Short tons	Value
New Hampshire, Vermont, Massachusetts, and Connecticut.....	47,987	\$358,391	39,064	\$288,714
Eastern New York, New Jersey, Georgia, and Florida.....	183,993	1,366,383	163,820	1,300,081
Western New York.....	506,177	2,805,805	372,781	2,048,641
Ohio and Virginia.....	305,410	1,893,021	301,622	1,912,805
Michigan and Indiana.....	344,150	1,913,787	339,543	1,928,014
Iowa.....	286,855	1,435,268	279,140	1,427,780
Kansas and Oklahoma.....	191,643	1,194,097	176,120	1,111,741
Texas.....	275,920	1,273,305	237,461	1,166,096
Colorado, Wyoming, South Dakota, Montana, and Utah.....	88,527	584,004	98,025	663,738
California and Nevada.....	327,068	1,927,526	355,547	2,033,530
	2,557,730	14,751,587	2,363,143	13,841,390

Active calcining plants and equipment in the United States, 1942-44, by States

State	1942			1943			1944		
	Cal-cining plants	Equipment		Cal-cining plants	Equipment		Cal-cining plants	Equipment	
		Kettles	Other cal-ciners ¹		Kettles	Other cal-ciners ¹		Kettles	Other cal-ciners ¹
California.....	3	7	4	3	7	4	4	7	6
Iowa.....	5	18	-----	5	19	-----	5	17	4
Michigan.....	5	22	-----	5	22	-----	4	20	-----
New York.....	7	22	6	7	22	6	7	22	6
Texas.....	4	26	-----	4	26	-----	4	24	-----
Other States ¹	29	77	14	26	73	14	23	61	23
	53	172	24	50	169	24	47	151	39

¹ Includes rotary and beehive kilns and grinding-calcining units, 1942-43; rotary and beehive kilns, grinding-calcining units, and hydrocol cylinders in 1944.

² 1942: 1 calcining plant each in Arizona, Connecticut, Florida, Georgia, Indiana, Massachusetts, New Hampshire, Oklahoma, Pennsylvania, South Dakota, and Vermont; 2 each in Colorado, Kansas, Montana, Nevada, New Jersey, Ohio, and Virginia; 4 calcining plants in Utah. 1943: 1 calcining plant each in Connecticut, Florida, Georgia, Indiana, Massachusetts, New Hampshire, Oklahoma, South Dakota, Vermont, and Wyoming; 2 each in Colorado, Kansas, Montana, Nevada, New Jersey, Ohio, Utah, and Virginia. 1944: 1 calcining plant each in Connecticut, Florida, Indiana, Massachusetts, Oklahoma, South Dakota, and Vermont; 2 each in Colorado, Kansas, Montana, Nevada, New Jersey, Ohio, Utah, and Virginia.

Thirty-five board plants operated at 67 percent of capacity in 1944 compared with 78 percent in 1943 and 82 percent the last 4 months of 1942. Capacity data are upon a time-utilized basis, in which 100 percent equals full operation for 85 percent of the total number of hours in each month. Highest activity was reached in February, lowest in July. Over-all activity of machines in Atlantic tidewater plants was well below that of machines in plants processing domestic crude.

DISTRIBUTION OF SALES BY USES

Percentage-wise the principal gypsum products maintained about the same order of sales in 1944 as during 1943. Figure 2 shows shifts in the sales pattern during the war, compared with sales in 1928. Of particular interest are the increasing importance of lath and the decline in building-plaster sales in 1940 and 1941 as compared with 1928, and also the greatly increased board sales, which began to level off only in 1944.

In figure 3, lath and board sales are correlated with the Dodge Corporation figures for floor area of construction in 37 States east of the Rocky Mountains. Although lath reached a wartime low in 1944, sales were not as low as the low construction curve would indicate. Probably most lath was sold for maintenance and repair and, with plaster, as a lumber substitute in partitions. Board sales were also higher proportionately than construction activity might predict and indicated wide replacement of construction lumber.

The year 1944 marked the 50th anniversary of gypsum board, which when first produced consisted of three layers of gypsum and

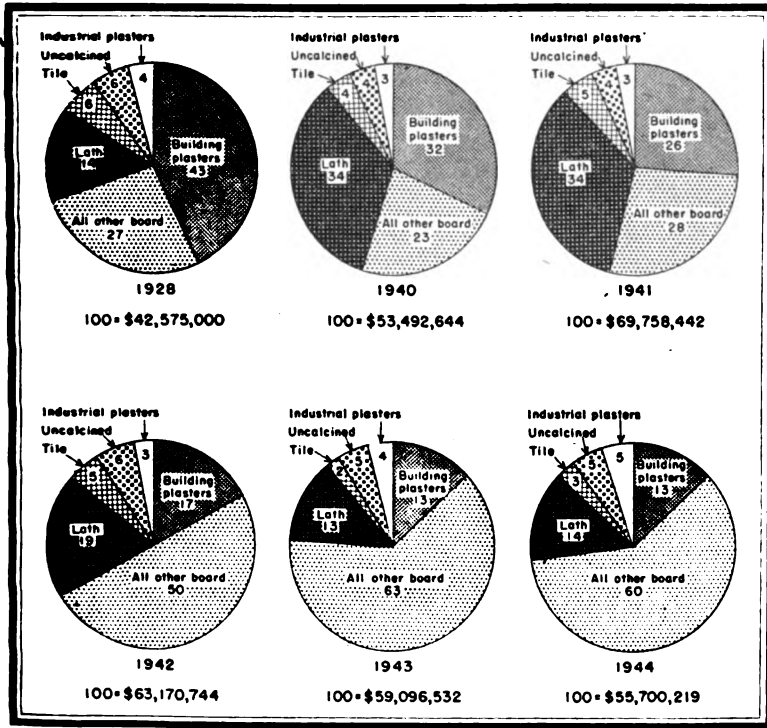


FIGURE 2.—Percentage distribution of total sales value, f. o. b. plant, of gypsum products in 1928 and 1940-44, by groups of products.

four alternate layers of wool felt paper and was used as lath. Gypsum wallboard proper was developed about 1912 and gypsum sheathing in 1925. These wallboards were made for interior use but could be used on the exterior if protected from the weather with wood siding, stucco, or brick veneer. When the war shortage of lumber began to press in 1942, replacements of waterproofed laminated gypsum board were developed for short-span roof decks and exterior siding, available in 1-, 1½-, and 2-inch thicknesses. This board is not load-bearing but weathers well if properly waterproofed and protected from standing water.

Gypsum board has been used increasingly in the construction and repair of farm buildings during the lumber shortage. Waterproofed sheathing and laminated board have been used in constructing chicken

houses, brooders, hog houses, and other service buildings. Since the beginning of the war, gypsum board has been introduced as a ceiling under barn haymows to inhibit the spread of hay fires.

Surfacing gypsum wallboard with aluminum to reflect radiant heat and thus increase insulating properties is not new. However, only recently has aluminum foil been used as a vapor barrier to prevent accumulation of water vapor in the exterior walls. The foil faces the air space.

It is reported that the Industrial Commission of Wisconsin has approved as a wartime measure the use of gypsum roof deck units on

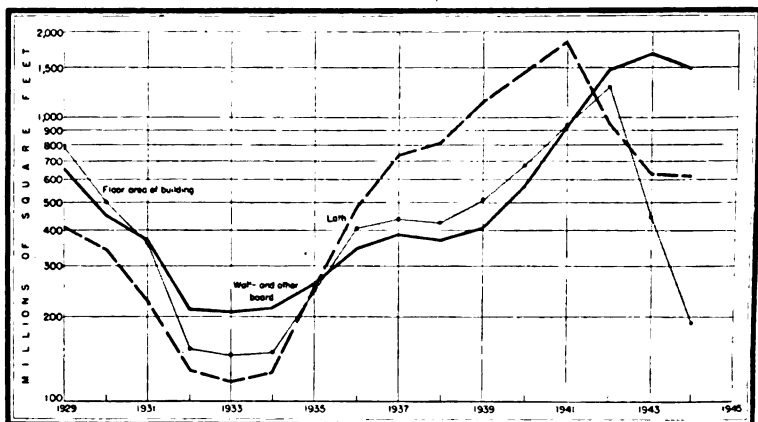


FIGURE 3.—Trends in sales of gypsum lath and wallboard and other board (includes wallboard, laminated board in terms of component board, and sheathing) compared with Dodge Corporation figures on floor area of residential and nonresidential building, 1929-44.

barns, garages, warehouses, and lumber sheds, for spans of 16 and 24 inches on pitched roofs.²

Haddon, a British writer, noted that plaster ceilings in Britain keyed to gypsum lath had stood up better in the blitz than ceilings keyed to wood lath.³

Sales of uncalcined gypsum for portland-cement retarder were less than half the record sales in 1942, and this severe decline was only partly offset by record sales of agricultural gypsum—"land plaster." Most of the consumption was in California, where it is used to neutralize black alkali soils and to supply sulfur. Considerable quantities also are used on the peanut crops in the Southeastern States.

² Rock Products, Approve Gypsum Boards: Vol. 47, No. 6, June 1944, p. 54.

³ Haddon, C. L., Gypsum Plaster Products: Chem. and Ind., No. 21, May 20, 1944, pp. 190-197

Gypsum products (made from domestic, imported, and byproduct crude gypsum) sold or used in the United States, 1943-44, by uses

Use	1943			1944			Percent of change in—	
	Short tons	Value		Short tons	Value		Ton-nage	Aver-age value
		Total	A ver-age		Total	A ver-age		
Uncalcined:								
Portland-cement retarder.....	835,495	\$1,762,414	\$2.11	565,030	\$1,184,061	\$2.10	-32	-----
Agricultural gypsum.....	382,346	1,201,704	3.14	477,033	1,613,078	3.38	+25	+8
Other uses ¹	15,886	150,671	9.48	14,213	156,425	11.01	-11	+16
Total uncalcined uses.....	1,233,727	3,114,789	-----	1,056,276	2,953,564	-----	-14	-----
Industrial:								
Plate-glass and terra-cotta plas-ters.....	20,000	131,441	6.57	25,545	171,716	6.72	+28	+2
Pottery plasters.....	34,803	460,374	13.23	31,588	420,994	13.33	-9	+1
Orthopedic and dental plasters.....	14,764	388,873	26.34	12,509	370,776	29.64	-15	+13
Other industrial uses ²	93,933	1,278,293	13.61	130,831	1,587,163	13.72	+39	+1
Total industrial uses.....	163,500	2,258,981	-----	200,473	2,550,649	-----	+23	-----
Building								
Cementitious:								
Plasters:								
Base-coat.....	527,596	4,720,209	8.95	521,357	4,669,030	8.96	-1	-----
Sanded.....	72,566	445,943	6.15	76,406	456,117	5.97	+5	-3
To mixing plants.....	24,851	112,931	4.54	19,063	107,653	5.65	-23	+24
Gauging and molding.....	74,002	868,091	11.73	77,838	910,629	11.70	+5	-----
Prepared finishes.....	4,329	107,135	24.75	5,647	141,863	25.12	+30	+1
Insulating and roof-deck.....	44,643	342,619	7.67	27,454	218,211	7.95	-39	+4
Other ³	13,456	563,552	44.11	13,758	643,649	46.78	+2	+6
Kesne's cement.....	8,019	125,630	15.67	12,422	191,588	15.42	+55	-2
Total cementitious.....	769,462	7,316,115	-----	753,945	7,338,740	-----	-2	-----
Prefabricated:								
Lath ⁴	475,000	7,863,506	\$12.47	470,109	7,908,857	\$12.64	\$-1	\$+1
Wallboard ⁵	1,027,534	27,296,293	\$21.68	974,972	26,507,684	\$21.94	\$-3	\$-1
Sheathing board ⁶	237,768	4,683,376	\$20.24	117,967	2,300,069	\$20.05	\$-50	\$-1
Laminated board ⁷	211,105	5,450,818	\$27.14	179,673	4,714,096	\$28.13	\$-17	\$+4
Tile ⁸	66,354	1,112,654	\$14.27	85,308	1,426,560	\$14.63	\$+29	\$-2
Total prefabricated.....	2,018,661	46,406,647	-----	1,828,029	42,857,266	-----	\$-9	-----
Total building uses.....	53,722,762	-----	-----	50,196,006	-----	-----	-----	-----
Grand total value.....	59,006,532	-----	-----	55,700,219	-----	-----	-----	-----

¹ Includes uncalcined gypsum sold for use as filler and rock dust, in brewer's fire, color manufacture, and for unspecified uses.

² Includes statuary, industrial casting and molding plasters, dead-burned filler, and miscellaneous uses.

³ Includes joint filler, patching and painter's plaster, and unclassified building plasters.

⁴ 1943: 630,639 M square feet; 1944: 625,553 M square feet.

⁵ Average value per M square feet.

⁶ Percent of change in square footage.

⁷ 1943: 1,241,828 M square feet; 1944: 1,208,158 M square feet.

⁸ 1943: 231,356 M square feet; 1944: 114,704 M square feet.

⁹ Square footage in terms of component board—1943: 200,815 M square feet; 1944: 167,580 M square feet.

¹⁰ Includes partition, roof, floor, solit, shoe, and all other gypsum tiles and planks—1943: 11,639 M square feet; 1944: 15,067 M square feet.

¹¹ Average value per M square feet of partition tile only.

Gypsum board and tile sold or used in the United States, 1940-44, by types

Year	Lath			Wallboard		
	M square feet	Value		M square feet	Value	
		Total	Average ¹		Total	Average ¹
1940.....	1,450,069	\$18,189,358	\$12.54	491,291	\$10,595,245	\$21.57
1941.....	1,843,648	23,524,812	12.76	757,568	16,578,698	21.88
1942.....	959,307	12,116,144	12.63	1,046,025	23,200,410	22.18
1943.....	630,639	7,863,506	12.47	1,241,828	27,296,293	21.98
1944.....	625,553	7,908,857	12.64	1,208,158	26,507,684	21.94

Year	Sheathing			Laminated board ²			Tile ³		
	M square feet	Value		M square feet	Value		M square feet	Value	
		Total	Average ¹		Total	Average ¹		Total	Average ¹
1940.....	89,631	\$1,632,688	\$18.22	-----	-----	-----	30,026	\$1,962,963	\$45.58
1941.....	175,496	3,287,699	18.73	-----	-----	-----	34,877	3,290,280	39.53
1942.....	369,313	7,016,015	19.00	⁴ 53,170	\$1,464,090	\$27.54	24,664	2,915,884	45.81
1943.....	231,356	4,683,376	20.24	⁴ 200,815	5,450,818	27.14	11,639	1,112,654	42.78
1944.....	114,704	2,300,069	20.05	⁴ 167,580	4,714,096	28.13	15,067	1,426,560	41.60

¹ Per M square feet, f. o. b. producing plant.² New product first marketed in 1942.³ Includes partition, roof, floor, soffit, shoe, and all other gypsum tiles and planks.⁴ Per M square feet, f. o. b. producing plant, of partition tile only.⁵ Reported as area of component board and not of finished product.

Sales of industrial plasters as a group reached record levels in 1944 owing to the demand for plaster models and patterns in tool shops. Sales in the plate-glass and terra-cotta subgroup were higher than in 1943, but full recovery cannot be expected until automobile wind-shields and windows are again made in mass quantities.

PRICES

The prices of gypsum products were frozen at March 1942 levels by Maximum Price Regulation 188 of the Office of Price Administration, with amendments as noted earlier in this chapter. About three-quarters of the gypsum produced is calcined by the producer and does not enter the open market. The remainder is sold largely as portland-cement retarder and agricultural gypsum. The average value for retarder sales was \$2.10 a short ton and for agricultural sales \$3.38. Average prices of calcined products increased over those of 1943, on the whole. Percentage deviations are noted in a preceding table.

RECENT DEVELOPMENTS

Schleede has summarized and illustrated the uses of gypsum industrial plasters in making patterns and models.⁴ A plaster "mock-up" of the P-63 fighter plane, built on an H-beam and reinforced with templates, has been the source of shell casts for tools from which the surface plates are stamped. The dimensions of the mock-up have not changed in the past 2 years. Over 2 tons of plaster were

⁴ Schleede, F. H., *Patterns of Gypsum Cement*, part 1: The Foundry, vol. 72, No. 14, October 1944, pp. 76-77, 224, 226, 228; part 2, vol. 72, No. 11, November 1944, pp. 90, 186, 188, 190, 192, 194.

consumed in this one model.⁵ A large proportion of pottery molds are made from gypsum calcined under pressure, which gives a very dense mold. Dailey has found that if all the relatively coarse particles (plus 75 microns) are removed from the pressure-molded plaster, it may be diluted with as much as 70 percent of regular plaster without adversely affecting its use. If the coarse particles are not removed when the dense material is mixed with regular plaster, differential wear occurs, the regular plaster wearing away first, leaving protrusions of the harder plaster which mar the surfaces of the molded pottery.⁶

The shortage of tinfoil has suggested changes in dental molds. Heretofore the plaster mold for a plate has been covered with tinfoil as contact between plaster and plate tends to blanch the latter during curing. Gold⁷ found that blanching does not occur if certain organic ingredients are added to the dry mix. On the other hand, it has been recommended that the mix formula remain unchanged but that the tinfoil be replaced by a sprayed water-soluble silicate film.⁸

Research on more reliable plate-glass bedding plasters was carried forward. Lime acts as a wetting agent and reduces expansion in such plasters, and to save time at the plate-glass mill the lime is generally added to the mix at the plaster plant. However, after the plaster is bagged, the lime tends to recarbonate on storage, and then it delays setting. Wiss proposes to eliminate lime and retain its advantages by the following formula: Calcined gypsum 96.9 to 97.3, portland cement 2.5, potassium sulfate 0.1 to 0.5, and calcium chloride 0.1 percent.⁹ Gardner suggests retaining the lime but stabilizing the setting time by adding portland cement and an accelerator: Calcined gypsum 81 to 98.9, lime 0.1 to 8.0, portland cement 1.0 to 8.0, and accelerator 0.01 to 3.0 percent.¹⁰

FOREIGN TRADE¹¹

Imports of crude gypsum during 1944 were mostly from Nova Scotia and New Brunswick, Canada. The small quantity listed as originating in the Dominican Republic was consumed in Puerto Rico. Most of the Nova Scotia receipts were landed at New York and a smaller quantity at Boston. About 15,000 tons were entered in the Virginia and Georgia customs districts for use as peanut fertilizers.

⁵ Steel, *Checks for Forming Tools*: vol. 116, No. 16, Apr. 16, 1945, pp. 122-124.

⁶ Dailey, M. C., *Plaster Composition and Process*: U. S. Patent 2,341,426, Feb. 8, 1944.

⁷ Gold, J. D., *Molding Composition*: U. S. Patent 2,371,688, Mar. 20, 1945.

⁸ Nelson, J. F., and Nauss, H. G., *Method for Forming Artificial Dentures*: U. S. Patent 2,358,730, Sept. 19, 1944.

⁹ Wiss, J. E., *Composition of Matter*: U. S. Patent 2,340,840, Feb. 1, 1944.

¹⁰ Gardner, H. F., *Hydraulic Composition*: U. S. Patent 2,358,701, Sept. 19, 1944.

¹¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Gypsum and gypsum products imported for consumption in the United States, 1940-44

Year	Crude (including anhydrite)		Ground		Calclined		Keene's cement		Alabaster manufactures ¹	Other manufactures, n. e. s.	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value			
1940.....	1,405,210	\$1,300,450	1,137	\$16,206	223	\$5,067	9	\$265	\$71,143	\$36,138	\$1,429,289
1941.....	1,347,957	1,225,152	1,631	30,499	242	6,416	34	945	3,232	15,896	1,282,140
1942.....	394,460	478,144	1,048	20,427	309	8,205	20	484	227	834	508,321
1943.....	231,323	275,503	958	18,002	73	1,950	16	392	1,064	6,343	304,154
1944.....	342,462	382,533	376	6,965	76	2,653	4	120	71	691	393,033

¹ Includes imports of jet manufactures, which are reported to be negligible.

Crude gypsum (including anhydrite) imported for consumption in the United States, 1942-44, by countries

Country	1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada.....	391,407	\$469,068	230,429	\$271,755	339,956	\$372,468
Dominican Republic.....	3,053	9,076	894	3,748	2,504	10,045
India and Dependencies.....					2	20
	394,460	478,144	231,323	275,503	342,462	382,533

Exports of wallboard were much higher in 1944 than during the previous year, and but for the labor shortage on the Atlantic seaboard they might have been even greater. The labor situation was a little better in the gypsum plants in the Ohio area, and the Office of Price Administration ruling in February 1945—that gypsum board from that area could be sold to Lend-Lease agencies at mill price plus freight to Atlantic port—may increase exports in 1945.

Gypsum and gypsum products exported from the United States, 1940-44

Year	Crude, crushed, or ground		Plasterboard and wallboard		Calclined		Other manufactures n. e. s.	Total value
	Short tons	Value	Square feet	Value	Short tons	Value		
1940.....	5,209	\$31,564	4,152,452	\$101,680	2,208	\$56,419	\$74,465	\$264,128
1941.....	15,491	72,877	13,560,482	296,848	3,041	90,397	69,452	528,574
1942.....	595	14,543	39,489,186	772,989	1,859	84,784	105,547	977,663
1943.....	5,300	22,405	2,953,173	84,163	2,436	98,229	78,923	283,720
1944.....	870	18,604	7,236,665	180,021	5,606	164,354	125,210	488,189

WORLD PRODUCTION

Very few production data by countries have been available since 1939, and the only figures available for 1944 are for the United States, Canada, Cuba, and Switzerland. Output in the United States, represented approximately one-third of the world production and is estimated to be about three times that of each of the next ranking countries—Germany and the United Kingdom. Other countries with important output, in probable order of tonnage, are Spain, France, and Russia.

World production of gypsum, 1938-44, by countries, in metric tons ¹

[Compiled by B. B. Waldbauer]

Country ¹	1938	1939	1940	1941	1942	1943	1944
Algeria.....	33,325	(?)	(?)	23,375	23,720	17,920	(?)
Anglo-Egyptian Sudan.....				748	1,558	3,641	(?)
Argentina ²	70,813	97,328	103,157	133,848	127,188	122,427	(?)
Australia:							
New South Wales.....	12,712	7,145	11,010	23,458	19,564	(?)	(?)
South Australia.....	148,943	147,266	155,901	115,323	58,124	40,157	(?)
Victoria.....	13,596	11,966	7,237	16,013	9,130	8,605	(?)
Western Australia.....	13,645	14,570	13,229	9,666	2,924	950	(?)
Belgian Congo.....	1,000	(?)	500	2,533	2,937	(?)	(?)
Brazil ⁴	2,000	2,000	2,000	(?)	(?)	(?)	(?)
Canada.....	983,435	1,390,183	1,397,778	1,415,600	723,137	390,833	⁴ 462,865
Chile.....	24,551	22,209	25,865	23,125	26,006	32,893	(?)
China.....	(?)	(?)	75,000	(?)	(?)	(?)	(?)
Cuba.....	7,257	6,270	12,000	12,000	4,303	2,921	9,008
Cyprus (exports).....	9,729	5,052	1,423	152	228	112	(?)
Egypt.....	212,088	700,166	169,723	130,942	118,931	91,881	(?)
Eire.....	13,364	16,168	21,662	24,660	16,567	21,453	(?)
Estonia.....	13,915	(?)	(?)	(?)	(?)	(?)	(?)
Greece.....	16,609	15,219	(?)	(?)	(?)	(?)	(?)
India, British.....	70,944	69,786	(?)	53,910	64,386	(?)	(?)
Iraq.....		69,545	34,879	(?)	(?)	(?)	(?)
Italy.....	425,299	(?)	(?)	(?)	(?)	(?)	(?)
Latvia.....	220,000	(?)	(?)	(?)	(?)	(?)	(?)
Luxembourg.....	19,801	245,035	(?)	(?)	(?)	(?)	(?)
New Caledonia.....	1,070	(?)	3,000	(?)	(?)	(?)	(?)
Palestine.....	3,864	4,524	4,403	4,841	8,118	5,990	(?)
Peru.....	14,026	15,655	21,478	22,472	(?)	(?)	(?)
Portugal.....	9,036	(?)	(?)	(?)	(?)	(?)	(?)
Rumania.....	66,079	(?)	(?)	(?)	(?)	(?)	(?)
Sweden.....	95	102	13	(?)	(?)	(?)	(?)
Switzerland.....	35,000	38,000	30,000	35,000	38,000	42,000	46,000
Union of South Africa.....	38,849	40,782	46,202	(?)	(?)	(?)	(?)
United Kingdom.....	1,109,928	1,042,760	1,032,275	1,196,900	1,231,613	1,389,914	(?)
United States.....	2,435,057	2,927,231	3,355,672	4,344,062	4,261,540	3,517,628	3,412,116

¹ In addition to the countries listed gypsum is produced in Austria, Chosen, Dominican Republic, France, French Morocco, Germany, Japan, Kenya, Mexico, Poland, Spain, Tunisia, U. S. S. R., and Yugoslavia, but production data are not available.

² Data not available.

³ Rail and river shipments.

⁴ Approximate production.

⁵ Sales.

LIME

By OLIVER BOWLES AND F. D. GRADJAN

SUMMARY OUTLINE

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SUMMARY

The lime industry in 1944 experienced remarkably little change compared with 1943. Sales of "open-market" lime totaled 6,473,563 short tons, receding 2 percent from the all-time high of 1943. The average price per ton advanced 8 cents. Quicklime represented 80 percent and hydrated lime 20 percent of the total, the same as in 1943. Sales of agricultural and refractory lime gained slightly, but building lime and that used in the chemical and processing industries experienced small declines. The most difficult problem with most operators was shortage of labor.

The steady decline in the number of producers, as indicated in the accompanying table of salient statistics, continued in 1944, with a drop of 35 in the number of active plants. Foreign trade data for 1943 and 1944, heretofore regarded as confidential because of military restrictions, may now be released, and the figures are included in this table. Foreign trade in lime is of minor importance.

The supply situation with respect to chemical lime was somewhat critical throughout the year. Threatened shortages were due partly to increased demands and partly to impediments to production, the chief of which were curtailment of industrial gas supplies, poor quality of fuel, and inadequate labor. Deliveries were impeded at times by shortages of cars. Allocation was not deemed necessary, but consumers were urged to place orders well in advance of delivery dates.

The most striking changes in chemical and industrial uses were the substantial increase in the requirements of the calcium carbide industry and the large decline in the quantity needed for ore concentration. However, throughout the whole field of industrial uses the gains and losses were nearly in balance.

The permitted maximum prices of building and chemical lime were continued through 1944 at the March 1942 level as fixed by Maximum Price Regulation 188. Amendments to Order A-1 of the regulation permitted upward revision of prices where shortages occurred. An increase of 45 cents a ton for certain producers of high-calcium lime in Ohio was authorized in April 1945, and an increase of 65 cents a ton was authorized for Virginia, North Carolina, South Carolina, Georgia, Alabama, Tennessee, Mississippi, and Louisiana in May 1945. These authorizations did not affect prices of agricultural lime, which were controlled by Maximum Price Regulation 386.

Late in 1944 an amendment to Order A-1, M. P. R. 188, was promulgated, permitting sale by one producer to another at a price exceeding the established maximum, provided the excess in price was absorbed by the buying producer.

Salient statistics of the lime industry in the United States, 1925-29 (average), 1935-39 (average), and 1942-44

	1925-29 (average)	1935-39 (average)	1942	1943	1944
Active plants.....	419	310	270	245	210
Sold by producers:					
By types:					
Quicklime..... short tons..	2, 871, 236	2, 488, 269	4, 810, 452	5, 283, 227	5, 150, 545
Hydrated..... do.....	1, 585, 631	1, 204, 128	1, 293, 339	1, 313, 388	1, 323, 018
Total lime:					
Short tons.....	4, 456, 867	3, 692, 397	6, 103, 791	6, 596, 615	6, 473, 563
Value ¹	\$38, 548, 498	\$26, 592, 115	\$44, 367, 441	\$49, 064, 328	\$48, 698, 162
Per ton.....	\$8.65	\$7.20	\$7.27	\$7.44	\$7.52
By uses:					
Agricultural..... short tons..	318, 224	350, 535	400, 631	454, 133	466, 390
Building..... do.....	2, 096, 744	870, 335	697, 677	557, 958	520, 000
Chemical and industrial..... do.....	1, 623, 885	1, 929, 947	3, 776, 126	4, 307, 799	4, 196, 383
Refractory (dead-burned dolomite)..... short tons..	418, 014	541, 580	1, 229, 357	1, 276, 725	1, 290, 790
Imported for consumption:					
Short tons.....	18, 683	14, 108	8, 549	15, 390	17, 788
Value.....	\$344, 887	\$240, 909	\$84, 875	\$148, 591	\$194, 382
Exported:					
Short tons.....	15, 762	10, 905	36, 061	23, 284	22, 689
Value.....	\$221, 177	\$123, 167	\$400, 845	\$255, 135	\$216, 642

¹ Selling value, f. o. b. plant, excluding cost of containers.

FUTURE TRENDS

Lime has a multitude of chemical uses, involving neutralization, precipitation, causticization, solution, dehydration, absorption, saponification, and catalysis. It either forms a part of, or enters into, the process of manufacture of innumerable products, and for most of its uses substitution of some other material is difficult or impossible. Because of its many and varied applications the growth of the chemical lime industry has in general followed the trend of industrial development. The abrupt termination of major hostilities in Europe on May 8, 1945, reawakened a latent demand for many industrial products that have been in short supply or entirely lacking for several years. Reconversion to peacetime industrial activity doubtless will take place as rapidly as is consistent with maximum military effort in the Pacific, and following a victorious conclusion of that campaign the manufacture of a multitude of machine products to satisfy deferred demands may be expected. Chemical lime will play an important part in any broad industrial program.

The predominant types of military construction that characterized the war years employed minimum quantities of mortar and plaster; hence, building-lime sales have reached a low ebb. An enormous program of private construction, deferred because of wartime restrictions and impediments, awaits initiation when favorable conditions—now in prospect—arrive, and when this great building program materializes the market for building lime will automatically broaden.

Agricultural liming materials have been in heavy demand to promote maximum output of farm products. Lime sales increased somewhat in response to this demand, but agricultural limestone responded more vigorously. The urgent need for chemical lime in war industries during 1943 and 1944 no doubt reduced the available supply of agricultural lime. Restricted food supplies in the United States and serious shortages abroad are strong incentives for increasing farm production, and such increase will call for larger supplies of liming materials.

PRODUCTION

Production in 1944 increased for agricultural and refractory uses but declined for building use and for application in the chemical and processing industries. As stocks of lime are small, the sales given in the following table are regarded as equivalent to production of "open-market" lime.

Lime sold by producers in the United States, 1943-44, by types and major uses

	1943				1944					
	Quantity		Value ¹		Quantity		Value ¹		Percent of change in—	
	Short tons	Percent of total	Total	Average	Short tons	Percent of total	Total	Average	Tonnage	Average value
By types:										
Quicklime.....	5,263,227	80	\$38,617,278	\$7.31	5,150,545	80	\$38,055,518	\$7.39	-3	+1
Hydrated lime.....	1,313,388	20	10,447,050	7.95	1,323,018	20	10,642,644	8.04	+1	+1
Total lime ²	6,596,615	100	49,064,328	7.44	6,473,563	100	48,698,162	7.82	-2	+1
By uses:										
Agricultural:										
Quicklime.....	184,028	3	1,092,898	5.94	168,364	2	1,085,217	6.45	-9	+9
Hydrated lime.....	270,105	4	2,041,763	7.56	298,026	5	2,291,658	8.02	+10	+6
	454,133	7	3,134,661	6.90	466,390	7	3,476,875	7.45	+3	+8
Building:										
Quicklime.....	129,139	2	1,169,167	9.05	126,944	2	1,225,216	9.65	-2	+7
Hydrated lime.....	428,819	7	3,685,103	8.59	393,056	6	3,261,816	8.30	-8	-3
	557,958	9	4,854,270	8.70	520,000	8	4,487,032	8.63	-7	-1
Chemical and industrial:										
Quicklime.....	3,693,335	56	25,112,196	6.80	3,564,447	55	24,303,473	6.82	-3	(³)
Hydrated lime.....	614,464	9	4,720,184	7.68	631,936	10	4,969,170	7.90	+3	+3
	4,307,799	65	29,832,380	6.93	4,196,383	65	29,292,643	6.98	-3	+1
Refractory (dead-burned dolomite).....	1,276,725	19	11,243,017	8.81	1,290,790	20	11,441,612	8.86	+1	+1

¹ Selling value, f. o. b. plant, excluding cost of containers.

² Includes lime used by producers (captive tonnage) as follows—1943: 434,571 tons, valued at \$2,457,785; 1944: 432,166 tons, \$2,570,544.

³ Less than 1 percent.

CAPTIVE TONNAGE

The captive tonnage (lime used by producers in their own operations) included in the figures for "open-market" lime in 1944 totaled 432,166 short tons valued at \$2,570,544. This total comprised 7,518 tons for masonry mortars, 318,276 tons for metallurgical uses, 18,368 tons for minor chemical uses, and 88,004 tons of refractory lime.

Captive tonnage presents a difficult statistical problem. An overall picture of total lime used in industry is desirable, but the figures most useful to the lime industry and to others who study lime manufacture from the standpoint of a commercial enterprise are those of "open-market" lime that freely enters trade. For any break-down of lime by uses, or by movement between States, it is highly desirable to keep the noncommercial figures separate from the commercial. Furthermore, any study of prices or unit values would be meaningless if the captive lime were combined with the open-market lime, because any value given to the former would be purely arbitrary.

For lime that is made and used in the same plant, calcination is merely one step in a series of chemical processes, and the lime loses its identity as lime in many instances, almost immediately after calcination. Accordingly, the captive tonnage if reported as limestone is included in the statistics on stone, and if reported as lime it is generally converted to its equivalent of limestone and also included in the statistics of stone. The limestone used to produce this captive tonnage has been included since 1921 in the chapters on Stone of Minerals Yearbook and its predecessor, Mineral Resources of the United States.

A figure for the total quantity of lime used in industry may be obtained by combining the chemical lime figures given in this chapter with those represented by limestone recorded in the chapter on Stone, as limestone that has been converted into lime in plants that use it in their own processes. The total chemical lime recorded in this chapter amounts to 4,196,383 tons. Lime produced from stone consumed in the alkali, carbide, glass, magnesium metal, magnesium carbonate, paper, and sugar industries as listed in the chapter on Stone amounted to approximately 4,757,800 tons. Hence, the total open-market and captive lime was about 8,954,183 tons in 1944. Except for the small tonnage of captive lime applied to special uses for which complete coverage is obtained in the lime reports, the detailed statistics that follow are confined to "open-market" lime.

PRODUCTION BY STATES

In 1944 lime was produced at 210 plants in 36 States and 2 Territories. Production by States and Territories, in so far as the figures may be segregated, is indicated in the following table.

Lime sold by producers in the United States, 1943-44, by States

State or Territory	1943			1944		
	Active plants	Short tons	Value	Active plants	Short tons	Value
Alabama.....	8	331,182	\$1,959,266	7	333,414	\$2,004,301
Arizona.....	3	71,044	556,345	3	61,091	527,792
Arkansas.....	2	(1)	(1)	2	(1)	(1)
California.....	9	168,502	1,749,668	9	130,763	1,441,604
Colorado.....	3	(1)	(1)	2	(1)	(1)
Connecticut.....	1	(1)	(1)	1	(1)	(1)
Florida.....	4	20,507	202,276	4	17,959	185,895
Georgia.....	1	8,513	59,514	1	6,079	44,315
Hawaii.....	1	7,633	123,172	1	8,726	140,776
Illinois.....	8	314,736	2,396,554	7	290,998	2,269,639
Indiana.....	3	(1)	(1)	2	(1)	(1)
Louisiana.....	1	(1)	(1)	1	(1)	(1)
Maine.....	2	(1)	(1)	2	(1)	(1)
Maryland.....	10	78,386	530,989	9	69,514	534,763
Massachusetts.....	5	94,877	783,999	3	87,295	745,573
Michigan.....	5	96,554	717,401	3	119,446	869,237
Minnesota.....	1	(1)	(1)	1	(1)	(1)
Missouri.....	11	963,301	6,046,453	11	908,340	5,820,028
Montana.....	2	(1)	(1)	2	(1)	(1)
Nevada.....	2	(1)	(1)	2	(1)	(1)
New Jersey.....	3	(1)	(1)	3	(1)	(1)
New Mexico.....	1	(1)	(1)	1	(1)	(1)
New York.....	5	121,890	976,692	4	193,395	1,410,969
North Carolina.....	1	(1)	(1)	1	(1)	(1)
Ohio.....	21	1,469,654	12,001,684	20	1,467,575	11,876,409
Oklahoma.....	3	(1)	(1)	1	(1)	(1)
Oregon.....	1	(1)	(1)	1	(1)	(1)
Pennsylvania.....	51	1,021,215	7,864,323	35	1,026,292	7,983,361
Puerto Rico.....	6	8,153	168,552	5	5,692	121,703
South Dakota.....	1	(1)	(1)	1	(1)	(1)
Tennessee.....	9	235,854	1,503,850	9	193,202	1,246,893
Texas.....	8	132,167	1,034,355	8	94,923	767,141
Utah.....	5	59,811	407,753	4	51,202	379,580
Vermont.....	5	51,011	357,265	4	45,624	294,932
Virginia.....	22	194,974	1,338,675	20	154,160	1,126,343
Washington.....	2	(1)	(1)	4	55,241	667,546
West Virginia.....	8	492,292	3,401,706	7	493,724	3,464,019
Wisconsin.....	11	82,913	633,399	9	138,760	1,080,222
Undistributed ¹	-----	571,446	4,260,437	-----	620,168	3,804,447
	245	6,596,615	49,064,323	210	6,473,563	48,698,163

¹ Included under "Undistributed."¹ Includes items entered as "(1)."

State or Territory	Agricultural		Building		Chemical and Industrial						Refractory		Total	
	Short tons	Value	Short tons	Value	Metallurgical		Paper mills		Tanneries		Water purification		Short tons	Value
					Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
Alabama.....	(1)	(1)	31,997	\$220,578	180,720	\$1,006,200	74,353	\$444,466	(1)	(1)	10,049	\$80,738	(1)	(1)
Arizona.....			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	333,414	\$2,004,391
Arkansas.....			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	61,001	\$27,792
California.....	(1)	(1)	29,911	369,390	35,132	356,847	6,839	68,475	1,175	\$15,351	9,708	95,561	130,793	1,441,004
Colorado.....					(1)	(1)	(1)	(1)					(1)	(1)
Connecticut.....	(1)	(1)											(1)	(1)
Florida.....	(1)	(1)	2,030	21,340							8,999	93,689	17,969	185,565
Georgia.....	238	\$1,191	5,841	44,124									8,079	46,315
Hawaii.....			1,411	23,736									8,726	140,776
Illinois.....	(1)	(1)	7,873	96,765	123,452	834,279	(1)	(1)	(1)	(1)			290,988	2,296,539
Indiana.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Louisiana.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Maine.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Maryland.....	59,521	468,056	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			69,514	534,743
Massachusetts.....	6,775	52,562	24,231	211,760	(1)	(1)	13,761	117,454	10,569	85,508	(1)	(1)	87,295	745,573
Michigan.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			119,446	889,337
Minnesota.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Missouri.....	(1)	(1)	29,398	212,333	223,801	1,264,845	(1)	(1)	(1)	(1)	70,823	475,468	908,340	5,830,028
Montana.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Nevada.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
New Jersey.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
New Mexico.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
New York.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			193,395	1,410,956
North Carolina.....	(1)	(1)	215,142	1,637,709	137,063	851,221	33,801	206,174	(1)	(1)			753,892	\$6,813,152
Ohio.....	76,707	548,554	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			1,467,575	11,876,409
Oklahoma.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Oregon.....	108,609	1,603,854	23,253	223,431	333,069	2,377,970	62,305	457,410	29,909	217,726	53,281	412,972	1,026,292	7,933,361
Pennsylvania.....	(1)	(1)	3,945	92,694	(1)	(1)	(1)	(1)	(1)	(1)			5,692	121,702
Puerto Rico.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
South Dakota.....	619	4,754	15,321	124,220	34,522	214,760	69,906	419,954	3,071	21,575	14,169	93,116	193,202	1,246,802
Tennessee.....	(1)	(1)	20,259	186,011	22,160	157,696	11,640	75,495	(1)	(1)	24,337	194,032	94,923	757,141
Texas.....	(1)	(1)	20,999	13,634	47,927	335,413	(1)	(1)	(1)	(1)	(1)	(1)	51,202	379,550
Utah.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	15,966	121,949	45,624	294,902
Vermont.....	32,534	265,210	7,492	55,025	41,958	278,319	16,585	112,109	(1)	(1)	(1)	(1)	154,160	1,129,342
Washington.....	4,805	29,331	3,815	24,809	234,744	1,560,486	(1)	(1)	(1)	(1)	7,355	48,309	55,241	667,546
West Virginia.....	28,761	149,064	13,385	115,998	(1)	(1)	26,405	210,415	(1)	(1)			138,750	3,464,019
Wisconsin.....	3,352	19,221	83,657	813,495	307,175	2,185,105	209,687	1,551,448	37,999	272,590	123,404	889,734	536,898	4,628,460
Undistributed.....	54,468	335,078							82,723	612,750	374,788	2,765,975	1,290,790	11,441,612
	466,390	3,476,875	520,000	4,487,032	1,727,937	11,494,848	532,391	3,742,157	82,723	612,750			6,473,563	48,698,162

* Included under "Undistributed."

* Includes items entered as "(1)."

Lime sold by producers in the United States, 1943-44, by uses

Use	1943			1944		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Agricultural	454, 133	\$3, 134, 661	\$6. 90	466, 390	\$3, 476, 875	\$7. 45
Building:						
Finishing lime.....	191, 425	1, 790, 001	9. 35	210, 188	1, 847, 655	8. 79
Mason's lime.....	267, 092	2, 234, 494	8. 37	224, 544	1, 924, 728	8. 57
Prepared masonry mortars.....	35, 174	244, 806	6. 96	27, 828	200, 527	7. 21
Unspecified.....	64, 267	584, 969	9. 10	57, 440	514, 122	8. 93
	557, 958	4, 854, 270	8. 70	520, 000	4, 487, 032	8. 63
Chemical and industrial:						
Acid neutralization.....	17, 763	131, 262	7. 39	(?)	(?)	(?)
Alkalies (ammonium, potassium, and sodium compounds).....	8, 011	57, 360	7. 16	3, 903	29, 796	7. 63
Asphalts and other bitumens.....	1, 547	13, 080	8. 46	720	4, 470	6. 21
Bleach, liquid and powder ¹	11, 620	86, 891	7. 48	11, 971	90, 036	7. 52
Brick, sand-lime and slag.....	5, 979	50, 217	8. 40	3, 118	27, 967	8. 97
Brick, silica (refractory).....	15, 204	127, 395	8. 38	15, 929	128, 574	8. 07
Calcium carbide and cyanamide.....	355, 092	2, 297, 924	6. 47	476, 810	3, 256, 788	6. 83
Chromates and bichromates.....	22, 969	149, 342	6. 50	34, 676	227, 646	6. 56
Coke and gas (gas purification and plant byproducts).....	30, 545	212, 126	6. 94	27, 389	189, 189	6. 91
Explosives.....	10, 093	73, 959	7. 33	21, 215	163, 827	7. 72
Food products:						
Creameries and dairies.....	3, 667	34, 156	9. 31	6, 608	65, 344	9. 89
Gelatin.....	5, 277	39, 416	7. 47	6, 834	52, 865	7. 74
Stock feed.....	(?)	(?)	(?)	5, 720	50, 022	8. 75
Other ²	4, 534	54, 585	12. 04	5, 924	58, 014	9. 79
Glassworks.....	208, 166	1, 534, 777	7. 37	210, 802	1, 553, 211	7. 37
Glue.....	9, 463	82, 248	8. 69	9, 131	67, 557	7. 40
Grease, lubricating.....	7, 391	48, 725	6. 59	1, 294	10, 986	8. 49
Insecticides, fungicides, and disinfectants.....	75, 125	616, 410	8. 21	79, 378	632, 573	7. 97
Magnesia (85 percent).....	33, 094	261, 308	7. 90	27, 526	280, 676	10. 20
Medicines and drugs.....	4, 922	30, 524	6. 20	6, 707	43, 156	6. 43
Metallurgy:						
Nonferrous smelter flux.....	9, 195	63, 050	6. 86	7, 436	55, 551	7. 47
Steel (open-hearth and electric furnace flux).....	1, 174, 654	7, 840, 972	6. 68	1, 173, 657	7, 817, 450	6. 66
Ore concentration ³	(880), 343	4, 683, 911	6. 90	496, 001	3, 221, 744	6. 50
Wire drawing.....	10, 395	97, 361	9. 37	15, 807	150, 700	9. 53
Other ⁴	25, 881	178, 700	6. 90	35, 036	249, 403	7. 12
Paints.....	8, 420	67, 762	8. 05	10, 398	85, 339	8. 21
Paper mills ⁵	543, 335	3, 753, 502	6. 91	532, 391	3, 742, 157	7. 03
Petroleum refining.....	28, 729	253, 584	8. 83	34, 126	297, 859	8. 73
Rubber manufacture.....	2, 039	15, 302	7. 50	5, 634	44, 571	7. 91
Salt refining.....	4, 648	29, 919	6. 44	5, 498	39, 479	7. 18
Sewage and trade-wastes treatment.....	17, 660	126, 448	7. 16	64, 189	478, 498	7. 45
Soap and fat.....	5, 745	34, 188	5. 95	6, 036	37, 065	6. 14
Sugar refining.....	21, 106	256, 161	12. 14	22, 789	257, 024	11. 26
Tanneries.....	69, 222	509, 005	7. 35	82, 723	612, 750	7. 41
Textiles.....	496	3, 944	7. 95	(?)	(?)	(?)
Varnish.....	230	1, 987	8. 64	806	7, 496	9. 30
Water purification.....	395, 830	2, 807, 009	7. 32	374, 788	2, 765, 975	7. 38
Wood distillation.....	1, 848	16, 499	8. 93	743	5, 910	7. 95
Undistributed ⁶	18, 345	135, 671	7. 40	23, 242	191, 104	8. 22
Unspecified.....	459, 216	2, 955, 700	6. 44	349, 428	2, 299, 851	6. 58
	4, 307, 799	29, 832, 380	6. 93	4, 196, 383	29, 292, 643	6. 96
Refractory lime (dead-burned dolomite)	1, 276, 725	11, 243, 017	8. 81	1, 290, 790	11, 441, 612	8. 86
Total lime⁷	6, 596, 615	49, 064, 328	7. 44	6, 473, 563	48, 698, 162	7. 52
Hydrated lime included in above distribution	1, 313, 388	10, 447, 050	7. 95	1, 323, 018	10, 642, 644	8. 04

¹ Excludes bleach used in paper mills.² Included under "Undistributed."³ Includes chocolate, cocoa, fruit juices, phosphate baking powders, and unspecified food products.⁴ Includes flotation, cyanidation, bauxite purification, and magnesium manufacture.⁵ Includes mold coating and unspecified.⁶ Includes bleach used in paper mills.⁷ Includes alcohol, bromine, calcium carbonate (precipitated), cement manufacture, dicalcium phosphate, photographic supplies, polishing compounds, retarder, rock wool, sulfur, tobacco, and wool pullers.⁸ Includes lime used by producers (captive tonnage) as follows—1943: 434,571 tons, valued at \$2,457,796; 1944: 432,166 tons, \$2,570,544.

PRODUCTION BY USES

The use pattern of lime shifts from year to year as circumstances change. During recent years the emphasis has been upon direct or indirect war uses. Agricultural, chemical, and industrial uses have attained much greater prominence than applications to the building trades.

Lime and other liming materials used in agriculture.—The total effective lime content of all agricultural liming materials sold in 1944 increased 29 percent over 1943. The principal gain as indicated in the following table was in agricultural limestone sales.

Building lime.—As there has been limited recent activity in the types of construction that employ lime as mortar or plaster, sales of building lime continued in 1944 the downward trend that has characterized the war years.

Agricultural lime and other liming materials sold by producers in the United States, 1943-44, by kinds

Kind	1943				1944			
	Short tons		Value		Short tons		Value	
	Gross	Effective lime content ¹	Total	Average	Gross	Effective lime content ¹	Total	Average
Lime:								
Quicklime.....	184, 028	156, 420	\$1, 092, 898	\$5. 94	168, 364	143, 110	\$1, 085, 217	\$6. 45
Hydrated lime.....	270, 105	189, 070	2, 041, 763	7. 56	298, 026	208, 620	2, 391, 658	8. 02
Oystershells (crushed) ²	93, 361	43, 880	374, 754	4. 01	97, 226	45, 700	214, 710	2. 21
Limestone.....	14, 521, 670	6, 825, 190	19, 057, 120	1. 31	18, 941, 220	8, 902, 370	25, 316, 219	1. 34
Calcareous marl.....	147, 153	61, 800	152, 821	1. 04	178, 036	74, 780	171, 599	. 96
.....	7, 276, 360		22, 719, 356		9, 374, 580		29, 179, 403	

¹ Effective lime contents as follows: Quicklime, 85 percent; hydrated lime, 70 percent; limestone and oystershells, 47 percent; calcareous marl, 42 percent.

² Figures supplied by Fish and Wildlife Service.

³ Preliminary figure.

Chemical and industrial lime.—Although there was a decided drop in the quantity of lime used in ore dressing, the over-all use in metallurgy amounted to nearly 27 percent of total lime sales in 1944. Paper making, the second largest use, continued its decline as in 1943, but calcium carbide manufacture consumed increasingly large quantities. This was to be expected because of the wide use of acetylene gas in welding and in the active program of synthetic rubber manufacture. Neutralization of waste acids was included in 1944 in the item designated "Sewage and trade-wastes treatment." This no doubt accounts for the large increase for this use indicated in the accompanying table.

HYDRATED LIME

Production of hydrated lime, which gained slightly in 1944, represented 20 percent of the total output compared with 20 percent in 1943 and 21 percent in 1942. Active hydrating plants numbered 140 and were distributed in 34 States and 2 Territories. The following table shows production by States.

Hydrated lime sold by producers in the United States, 1943-44, by States

State or Territory	1943			1944		
	Active plants	Short tons	Value	Active plants	Short tons	Value
Alabama.....	6	32,659	\$282,040	5	35,528	\$283,558
California.....	7	35,871	441,121	7	32,008	381,378
Florida.....	3	7,279	75,531	3	10,245	106,978
Georgia.....	1	7,549	54,989	1	6,079	45,315
Hawaii.....	1	7,597	121,552	1	8,686	138,976
Illinois.....	4	31,451	239,452	5	37,001	282,527
Maryland.....	5	34,880	234,981	5	30,652	226,751
Massachusetts.....	5	48,042	383,969	3	47,732	389,906
Michigan.....	3	6,154	56,463	(1)	(1)	(1)
Missouri.....	9	190,757	1,239,035	9	196,196	1,364,397
New York.....	3	14,441	113,043	3	14,580	109,166
Ohio.....	16	334,884	2,638,572	16	326,366	2,421,907
Pennsylvania.....	17	234,064	1,913,430	15	251,156	2,118,008
Puerto Rico.....	3	4,401	100,600	3	3,827	88,856
Tennessee.....	8	46,366	366,966	7	43,790	343,491
Texas.....	5	32,308	304,244	5	35,075	332,657
Virginia.....	14	57,501	414,767	13	48,200	332,803
West Virginia.....	5	34,657	217,301	5	43,496	274,440
Other States ¹	34	151,327	1,248,998	34	152,591	1,340,530
	149	1,313,388	10,447,050	140	1,323,018	10,642,644

¹ Included under "Other States."

¹ 1943: Arizona (2 active plants), Arkansas (2), Colorado (1), Connecticut (1), Indiana (3), Louisiana (1), Maine (2), Minnesota (1), Montana (1), Nevada (1), New Jersey (3), North Carolina (1), Oklahoma (1), Oregon (1), South Dakota (1), Utah (2), Vermont (2), Washington (2), and Wisconsin (6). 1944: Arizona (2), Arkansas (2), Colorado (1), Connecticut (1), Indiana (2), Louisiana (1), Maine (2), Michigan (2), Minnesota (1), Montana (1), Nevada (1), New Jersey (3), North Carolina (1), Oregon (1), South Dakota (1), Utah (2), Vermont (3), Washington (2), and Wisconsin (5).

Uses.—The use of hydrated lime in building construction, metal-lurgy, insecticides, and water purification declined considerably. The most notable gains were in agriculture, food products, sewage treatment, and sugar manufacture. Although direct sales for insecticide use show a decline, considerable quantities sold for agricultural use probably were employed by farmers as insecticide.

Hydrated lime sold by producers in the United States, 1943-44, by uses

Use	1943			1944		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Agricultural.....	270,105	\$2,041,763	\$7.56	298,026	\$2,391,658	\$8.02
Building.....	428,819	3,685,103	8.59	393,056	3,261,816	8.30
Chemical and Industrial:						
Brick, silica.....	12,359	106,973	8.66	12,124	102,603	8.46
Coke and gas.....	2,827	24,964	8.83	2,595	19,727	7.60
Food products.....	8,742	86,657	9.91	14,765	138,604	9.39
Glass.....	3,094	22,571	7.30	2,815	22,985	8.17
Insecticides.....	57,747	484,706	8.39	50,192	427,127	8.51
Metallurgy.....	52,842	406,420	7.69	43,750	356,227	8.14
Paints.....	5,044	42,472	8.42	7,444	62,249	8.36
Paper mills.....	25,262	179,478	7.10	26,069	199,568	7.66
Petroleum.....	23,907	215,937	9.03	24,843	235,172	9.46
Sewage.....	6,293	52,666	8.37	14,324	120,900	8.44
Sugar.....	13,194	166,728	12.64	16,752	198,535	11.85
Tanneries.....	41,622	312,852	7.52	47,445	363,522	7.66
Water purification.....	182,088	1,407,496	7.73	168,117	1,327,414	7.90
Other uses.....	179,443	1,210,264	6.74	200,681	1,414,537	7.05
	614,464	4,720,184	7.68	631,936	4,989,170	7.90
Total hydrated lime.....	1,313,388	10,447,050	7.95	1,323,018	10,642,644	8.04

TRENDS IN PRINCIPAL USES

Building-lime sales generally follow the trend of total new construction, but as indicated in figure 1, since 1939 their paths have

diverged widely. Total new construction made decisive gains, but building-lime sales dropped to low levels because war construction dominated all building activities. For the past 20 years, refractory lime (dead-burned dolomite) used for furnace linings and lime em-

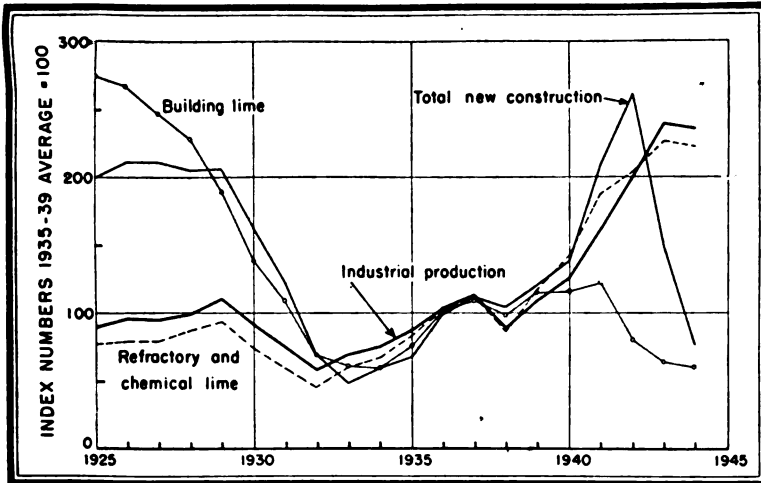


FIGURE 1.—Sales of refractory and building lime compared with total new construction and industrial production, 1925-44. Units are reduced to percentages of the 1935-39 average. Statistics on value of construction from the Bureau of Foreign and Domestic Commerce and on industrial production from the Federal Reserve Board.

ployed in the chemical and manufacturing industries, as shown in figure 1, have followed very closely the volume of industrial production.

Trends in sales of "open-market" lime for its principal uses during the past 20 years are indicated in figure 2. Except for the moderate

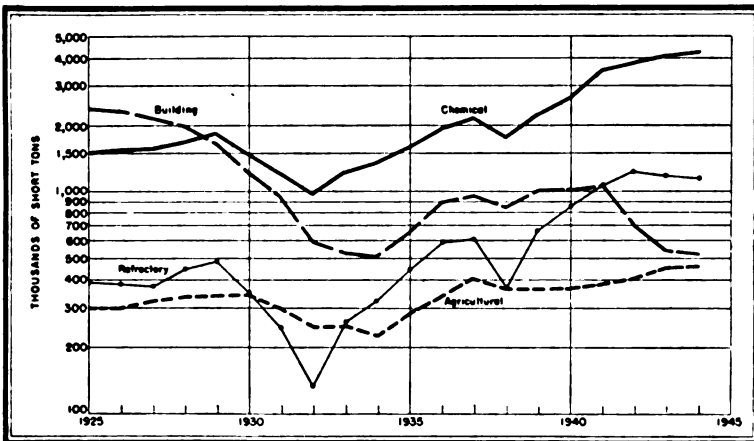


FIGURE 2.—Trends in major uses of lime, 1925-44.

recession in 1938, chemical lime has shown a strong upward trend since 1932, although there was a slight decline in 1944. Building lime receded greatly during the depression, recovered moderately thereafter, but dropped precipitously during the war years. Refractory lime

(dead-burned dolomite) has followed a course closely paralleling that of chemical lime. Sales of agricultural lime have experienced only moderate fluctuations throughout the 20-year period.

SHIPMENTS

Total shipments.—Output exceeded apparent consumption in 13 of the 36 lime-producing States in 1944. The excess of out-of-State over into-State movements was large only in Missouri, Ohio, Tennessee, and West Virginia.

Sales, shipments, and supplies of lime available for consumption in continental United States, by States and groups of States, are listed in the two following tables:

Lime supplies available in continental United States in 1944, by States, in short tons

State	Sales by producers	Shipments from State ¹	Shipments into State	Supply		
				Quicklime	Hydrated lime	Total
Alabama.....	333,414	86,356	51,846	282,829	16,075	298,904
Arizona.....	61,091	2,914	5,010	60,407	3,780	64,187
Arkansas.....	(²)	(²)	(²)	127,507	2,445	130,952
California.....	130,763	13,118	43,081	123,154	37,572	160,726
Colorado.....	(²)	(²)	(²)	40,216	5,294	45,510
Connecticut.....	(²)	(²)	(²)	17,847	8,821	26,668
Delaware.....	.....	.....	62,162	41,463	20,699	62,162
District of Columbia.....	.....	.....	6,324	41,426	5,898	6,324
Florida.....	17,959	.....	44,971	29,043	23,887	62,930
Georgia.....	6,079	1,420	59,864	46,156	18,367	64,523
Idaho.....	.....	.....	2,707	1,196	1,511	2,707
Illinois.....	290,988	96,837	278,867	390,269	82,749	473,018
Indiana.....	(²)	(²)	(²)	150,153	26,257	176,410
Iowa.....	.....	.....	63,768	49,234	14,534	63,768
Kansas.....	.....	.....	30,261	15,493	14,768	30,261
Kentucky.....	.....	.....	193,271	182,033	11,238	193,271
Louisiana.....	(²)	(²)	(²)	89,128	17,679	106,807
Maine.....	(²)	(²)	(²)	60,961	6,889	67,850
Maryland.....	69,514	15,030	139,672	112,855	81,301	194,156
Massachusetts.....	87,295	51,920	30,134	34,869	30,640	65,509
Michigan.....	119,446	80,913	198,758	186,117	51,174	237,291
Minnesota.....	(²)	(²)	(²)	55,058	10,228	65,286
Mississippi.....	.....	.....	10,905	6,349	4,556	10,905
Missouri.....	908,340	643,992	33,714	188,901	109,161	298,062
Montana.....	(²)	(²)	(²)	42,980	3,117	46,097
Nebraska.....	.....	.....	7,464	2,680	4,784	7,464
Nevada.....	(²)	(²)	(²)	34,040	172	34,212
New Hampshire.....	.....	.....	6,528	4,621	1,907	6,528
New Jersey.....	(²)	(²)	(²)	72,382	89,651	162,033
New Mexico.....	(²)	(²)	(²)	1,468	3,739	5,207
New York.....	193,395	63,609	245,996	289,635	86,147	375,782
North Carolina.....	(²)	(²)	(²)	38,176	26,094	64,270
North Dakota.....	.....	.....	7,540	430	7,110	7,540
Ohio.....	1,467,575	939,862	340,378	760,509	107,582	868,091
Oklahoma.....	(²)	(²)	(²)	12,697	6,903	19,600
Oregon.....	(²)	(²)	(²)	30,973	5,772	36,745
Pennsylvania.....	1,026,292	451,306	516,507	911,946	179,547	1,091,493
Rhode Island.....	.....	.....	9,172	5,236	3,936	9,172
South Carolina.....	.....	.....	9,712	3,886	5,826	9,712
South Dakota.....	(²)	(²)	(²)	588	4,639	5,225
Tennessee.....	193,202	152,498	8,231	21,285	27,650	48,935
Texas.....	94,923	34,467	20,526	50,770	30,212	80,982
Utah.....	51,202	2,792	6,429	48,860	5,979	54,839
Vermont.....	45,624	17,166	247	28,035	670	28,705
Virginia.....	154,100	97,244	71,037	91,819	36,134	127,953
Washington.....	55,241	25,761	9,967	28,601	10,846	39,447
West Virginia.....	493,724	453,624	203,085	226,909	16,376	243,285
Wisconsin.....	138,750	74,557	80,095	113,397	30,891	144,288
Wyoming.....	.....	.....	1,242	185	1,057	1,242
Undistributed ³	520,168	240,180	712,884	.....	.....	.....
	6,459,145	3,545,466	3,513,355	5,123,770	1,303,264	6,427,034

¹ Includes 32,111 tons exported or unclassified as to destination.

² Included under "Undistributed."

³ Includes items entered as "(?)."

Lime shipped (supply) in continental United States, in 1944, by origin and destination of shipments, in short tons

Destination	Origin											
	Illinois, Indiana, Michigan, Ohio			Maryland, New Jersey, New York, Pennsylvania, West Virginia			Connecticut, Maine, Massachusetts, Vermont			Florida, Georgia, North Carolina, Virginia		
	Quick-lime	Hy-drated lime	Total	Quick-lime	Hy-drated lime	Total	Quick-lime	Hy-drated lime	Total	Quick-lime	Hy-drated lime	Total
Illinois, Indiana, Michigan, Ohio.....	990,305	211,349	1,201,654	203,722	8,571	212,293	14	60	74	11,137	1,030	12,167
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia.....	423,539	99,250	522,789	1,127,986	338,078	1,466,064	15,682	22,346	38,028	57,574	15,564	73,138
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont.....	2,423	7,909	10,332	88,806	6,049	94,855	89,945	38,700	128,645	270	205	475
Florida, Georgia, North Carolina, South Carolina, Virginia.....	7,757	22,800	30,557	40,707	14,949	55,656	-----	-----	-----	44,683	45,734	90,427
Alabama, Kentucky, Louisiana, Mississippi, Tennessee.....	55,880	13,591	69,471	2,537	86	2,623	-----	-----	-----	-----	1,650	1,650
Arkansas, Kansas, Nebraska, Oklahoma, Texas.....	3,185	2,740	5,925	133	15	148	-----	-----	-----	-----	-----	-----
Iowa, Minnesota, Missouri, Wisconsin.....	56,041	28,905	84,946	-----	-----	-----	-----	-----	-----	-----	-----	-----
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming.....	13,985	643	14,528	78	-----	78	-----	-----	-----	-----	-----	-----
											2,000	2,000

Lime shipped (supply) in continental United States, in 1944, by origin and destination of shipments, in short tons—Continued.

Destination	Origin									
	Arkansas, Oklahoma, Texas			Minnesota, Missouri, Wisconsin			Arizona, California, Colorado, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington			
	Quick-lime	Hydrated lime	Total	Quick-lime	Hydrated lime	Total	Quick-lime	Hydrated lime	Total	United States
Illinois, Indiana, Michigan, Ohio, Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia, Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, Florida, Georgia, North Carolina, South Carolina, Virginia, Kentucky, Louisiana, Mississippi, Tennessee, Arkansas, Kansas, Nebraska, Oklahoma, Texas, Iowa, Minnesota, Missouri, Wisconsin, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming-----	150 ----- 123 1,136 40,113 116,328 26,105 6,183	2,120 2 ----- ----- 4,555 36,720 180 5,643	2,270 2 123 1,136 44,668 153,048 26,285 11,836	280,857 17,257 2 9,553 165,316 89,501 324,444 8,590	43,613 2,808 ----- 929 7,797 20,307 135,714 12,956	324,470 20,065 2 10,482 173,113 109,808 460,158 21,546	----- ----- ----- ----- ----- ----- ----- 384,350	----- ----- ----- ----- ----- 345 ----- 69,346	----- ----- ----- ----- 345 ----- ----- 453,696	267,762 479,619 52,803 110,308 77,198 60,112 164,814 90,598
										1,754,810 2,135,235 204,432 329,388 638,822 299,259 571,404 503,684

The accompanying table shows the relatively small quantities of lime shipped from continental United States to various island Territories.

Lime shipped to noncontiguous Territories of the United States, 1941-44

Territory	1941		1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Hawaii.....	526	\$9,069	1,217	\$16,034	1,170	\$17,528	(¹)	(¹)
Puerto Rico.....	710	9,186	1,162	15,343	4	170	415	\$5,572
Virgin Islands.....	80	1,035	111	2,010	103	3,462	121	3,876

¹ Data not available for publication.

Hydrated-lime shipments.—The distribution of hydrated lime into groups of States from all producing plants and from Ohio, the most productive State, is listed in the following table.

Shipments of hydrated lime from plants in continental United States and in Ohio in 1944, by destinations

Destination	From all plants		From Ohio plants		
	Short tons	Distribution (per-cent)	Short tons	Distribution (per-cent)	Percent of total shipments
Illinois, Indiana, Michigan, Ohio.....	267,762	20	166,933	51	62
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia.....	479,619	37	98,721	30	21
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont.....	52,863	4	7,889	3	15
Florida, Georgia, North Carolina, South Carolina, Virginia.....	110,308	8	22,800	7	21
Alabama, Kentucky, Louisiana, Mississippi, Tennessee.....	77,198	6	10,100	3	13
Arkansas, Kansas, Nebraska, Oklahoma, Texas.....	60,112	5	2,500	1	4
Iowa, Minnesota, Missouri, Wisconsin.....	164,814	13	16,582	5	10
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming.....	90,588	7	643	(¹)	1
Undistributed and exports.....	7,241	(¹)	138	(¹)	2
	1,310,505	100	326,366	100	25

¹ Less than 1 percent.

MILL VALUES

The net mill realization (excluding container cost) per ton of lime sold in the open market in 1944 averaged \$7.52, a gain of 8 cents over 1943 and 25 cents over 1942. The small gain in 1944 evidently reflects the upward revisions allowed by the Office of Price Administration in certain localities. The largest increase (55 cents) was in agricultural lime. Chemical and refractory lime increased 5 cents a ton, whereas building lime declined 7 cents.

NEW DEVELOPMENTS

Ordinary magnesium lime hydrates are generally incompletely hydrated. Recent tests at the National Bureau of Standards have demonstrated that when they are almost completely hydrated by

special treatment they possess superior qualities when used in masonry mortars.

Increasing interest is apparent in the recovery and re-use of lime used in water softening. The sludge contains not only lime carbonate derived from the original lime added to the water but additional carbonate precipitated from the water itself. The difficulty of sludge disposal has created a strong tendency toward developing methods of utilization. The material recovered may be used as a finely divided calcium carbonate for the whiting trade, or it may be recalcined and re-used in water treatment.

SIZE OF PLANTS

The trend that has been apparent during the war years toward inactivity of small lime plants continued in 1944. The large plants have evidently been able to weather the difficulties due to labor shortage and price restrictions better than the small plants. The output of all plants producing less than 25,000 tons was only 13 percent of total lime production in 1944; in 1943 it was 15 percent.

Distribution of lime (including refractory) plants, 1942-44, according to size of production

Size group (short tons)	1942			1943			1944		
	Plants	Production		Plants	Production		Plants	Production	
		Short tons	Percent of total		Short tons	Percent of total		Short tons	Percent of total
Less than 1,000.....	48	17,844	(1)	40	15,397	(1)	25	10,929	(1)
1,000 and less than 5,000.....	72	195,265	3	61	164,490	2	45	120,763	2
5,000 and less than 10,000.....	28	192,497	3	22	170,838	3	28	194,032	3
10,000 and less than 25,000.....	49	802,353	13	41	644,329	10	35	532,642	8
25,000 and less than 50,000.....	39	1,383,782	23	41	1,497,964	23	35	1,267,897	20
50,000 and less than 100,000.....	21	1,441,995	24	24	1,549,527	23	27	1,788,065	28
100,000 and over.....	13	2,070,055	34	16	2,554,050	39	15	2,559,235	39
	270	6,103,791	100	245	6,598,615	100	210	6,473,563	100

¹ Less than 1 percent.

FOREIGN TRADE ¹

Imports.—Lime imports are confined principally to movements from Canada to points in the State of Washington.

Lime imported for consumption in the United States, 1940-44

Year	Hydrated lime		Other lime		Dead-burned dolomite ¹		Total	
	Short tons ²	Value	Short tons ²	Value	Short tons	Value	Short tons	Value
1940.....	712	\$6,558	8,493	\$75,330	-----	-----	9,205	\$81,888
1941.....	808	8,827	11,747	100,127	64	\$654	12,619	109,608
1942.....	655	6,722	7,445	66,893	449	11,260	8,549	84,873
1943.....	740	6,670	13,911	119,358	739	22,563	15,390	148,591
1944.....	380	3,323	17,368	190,368	40	691	17,788	194,382

¹ "Dead-burned basic refractory material containing 6 percent or more of lime and consisting chiefly of magnesite and lime."

² Includes weight of immediate container.

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Lime imported for consumption in the United States, 1942-44, by countries and customs districts ¹

Country	Customs district	1942		1943		1944	
		Short tons ²	Value	Short tons ²	Value	Short tons ²	Value
Canada.....	(Buffalo.....)	225	\$2,247	120	\$882	80	\$556
	Los Angeles.....	106	785				
	Maine and New Hampshire.....			40	336	62	43,306
	Oregon.....	1	25				
	St. Lawrence.....	2,080	22,777				
	San Francisco.....			2	21		
Dominican Republic....	Vermont.....	5,635	47,325	14,489	124,789	17,616	149,739
	Washington.....	44	456				
	Puerto Rico.....						
		8,100	73,615	14,651	126,028	17,748	193,601

¹ Exclusive of dead-burned basic refractory material.

² Includes weight of immediate container.

Exports.—Export trade in lime is confined almost entirely to countries of the Western Hemisphere, chiefly Canada, Costa Rica, Honduras, Mexico, and Panama.

Lime exported from the United States, 1940-44

Year	Short tons	Value	Year	Short tons	Value
1940.....	31,912	\$311,610	1943.....	23,284	\$255,135
1941.....	46,500	475,540	1944.....	22,689	216,642
1942.....	36,061	400,845			

Lime exported from the United States, 1942-44, by countries

Country	1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value
Argentina.....	10	\$289	22	\$870	6	\$321
Bahamas.....	28	1,284	6	125	51	892
Brazil.....	11	291	11	473	68	1,471
Canada.....	8,984	64,202	8,930	70,735	7,507	35,816
Chile.....	60	1,061	15	293	54	1,346
Colombia.....	369	4,418	30	483	8	163
Costa Rica.....	2,465	21,456	2,913	35,309	1,473	18,235
Cuba.....	91	1,869	37	511	33	404
Curaçao (N. W. I.).....	97	729	74	762	22	440
Dominican Republic.....	7	123	149	2,749	114	1,081
El Salvador.....	86	1,324	39	678	83	1,673
Haiti.....	408	4,677	862	10,647	566	7,007
Honduras.....	10,674	129,990	6,489	83,531	7,811	84,320
Liberia.....	18	273	57	1,353	25	699
Mexico.....	1,494	12,698	1,260	14,778	2,010	28,969
Nicaragua.....	1,730	9,935	188	3,501	107	2,231
Panama, Republic of.....	1,827	20,065	1,908	23,351	2,586	26,177
Peru.....	337	2,866	154	2,420	74	1,221
United Kingdom ¹	87	3,013			38	1,854
Other countries.....	7,278	120,282	140	2,566	53	2,322
	36,061	400,845	23,284	255,135	22,689	216,642

¹ United Kingdom of Great Britain and Northern Ireland.

CLAYS

By G. W. JOSEPHSON AND A. LINN¹

SUMMARY OUTLINE

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GENERAL SUMMARY

Some clays that have specialized industrial uses fared very well in 1944, whereas others that serve the construction field were at a very low ebb.

As the country lacked both the material components and manpower required for a large building program the brick industry operated at only a small fraction of its capacity. Some companies had difficulty in satisfying even the local demand, but usually this was due to suspension of output from competitive brick plants and to lack of manpower. The combination of low volume, increased costs, and frozen prices made profitable operation difficult and in some cases impossible.

Although fire clays felt the decline in construction of new furnaces, sales for furnace maintenance minimized the decrease in demand.

Bentonite took advantage of the expanded oil-well drilling program that required large quantities for drilling mud and again established a new production record.

Capacity output of petroleum products has rejuvenated fuller's earth, and by 1944 it had recovered nearly all the volume lost during the depression.

Ball clay and kaolin experienced good but not record sales.

In response to urgent requests from producers the Office of Price Administration authorized some minor price increases to offset costs that have risen during the war.

Some care should be exercised in comparing the clay statistics recorded in this chapter with those of previous years. Formerly the Bureau of Mines attempted to confine its statistics to "merchant clay," the tonnage that is marketed as raw or beneficiated clay. This practice presented a reasonably complete report for kaolin, ball clay, bentonite, and fuller's earth; but for fire clay and the "miscellaneous" clays it proved inadequate, as such a large proportion of the total

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

production of these types comes from mines operated by the companies that convert the clay into brick and other products before sale. During the past few years somewhat more complete information was provided by including all material that was mined at such a distance from the kilns that "shipment" of the raw clay was required before delivery to the plant. However, it is believed that a report showing the quantity of clay sold on the open market, the captive tonnage, and the total clay sold or used by producers will be of greater value, and that general principle is followed in this chapter. Comparability with former years is indicated at appropriate points in the following discussion of individual types.

Salient statistics of the clay industry in the United States, 1943-44

	1943		1944	
	Short tons	Value	Short tons	Value
Domestic clay sold or used by producers:				
Kaolin or china clay.....	929,437	\$8,067,322	873,056	\$7,858,740
Ball clay.....	147,785	1,271,474	155,667	1,376,096
Fire clay, including stoneware clay.....	7,798,233	17,218,446	6,344,383	14,167,118
Bentonite.....	480,202	2,997,754	546,768	3,605,988
Fuller's earth.....	1247,258	12,664,027	294,737	3,297,004
Miscellaneous clays.....	11,215,276	7,485,955	9,080,717	6,550,269
	20,818,191	39,704,978	17,295,328	36,855,275
Imports:				
Kaolin or china clay.....	55,565	584,532	45,890	487,237
Common blue and Gross-Almerode.....	15,509	136,902	17,597	159,006
Fuller's earth.....	196	2,634	308	4,284
Other clay.....	247	6,625	2,712	10,602
	71,517	730,693	66,507	661,129
Exports:				
Fire clay.....	97,391	647,851	87,737	571,111
Other clay (including fuller's earth).....	66,177	1,166,438	93,462	1,497,451
	163,568	1,814,289	181,190	2,068,562

¹ Revised figure.

POSTWAR PROSPECTS

In 1944 the average operator of a structural-clay products plant would have expressed himself as discouraged with current conditions, but he anticipates a large market after the war. The need for new homes and other structures has been accumulating for years, and although serious financial problems remain to be solved it is generally felt that a major building program is coming. Virtually all postwar studies indicate that construction will be encouraged as a means of achieving the desired level of employment. Probably a fair share of the building dollar would come to the brick plant simply from habit, but progressive companies are improving their products, plants, and methods to enable them to hold their markets in the face of the strong competition that is expected from wood, glass, plastics, metal, and other structural materials.

As fire clay, bentonite, and fuller's earth are closely coupled to war production they are expected to decline somewhat, but as they also serve peacetime industry their prospects are linked to the success of the general reconversion program.

Competition of foreign clays will be felt by ball clay and kaolin when shipping is again freely available, but American clays have price advantages and qualities that should enable them to hold their own.

CONSUMPTION AND USES

The accompanying table showing the tonnages of domestic clays consumed in various uses continues a series begun in 1921. The quantities shown for kaolin, ball clay, fuller's earth, and bentonite are directly comparable with those published in Minerals Yearbook, 1943. On the other hand, the fireclay and miscellaneous clay figures are only partly comparable with 1943, as they now include all the clay in each class rather than being limited to the quantity shipped. The figures that are not comparable are indicated by footnotes.

Clay sold or used by producers in the United States in 1944, by kinds and uses, in short tons

Use	Kaolin	Ball clay	Fire clay and stoneware clay	Bentonite	Fuller's earth	Miscellaneous clay including slip clay	Total
Pottery and stoneware:							
Whiteware, etc.	83, 273	138, 923	1, 837				224, 033
Stoneware, including chemical stoneware			28, 585				28, 585
Art pottery and flower pots	631	560	16, 220			18, 180	35, 591
Slip for glazing						418	418
	83, 904	139, 483	46, 642			18, 598	288, 627
	9, 802	8, 980	45, 663			9, 107	73, 552
Tile, high-grade							
Kiln furniture:							
Saggers, pins, stilts	1, 491	383	24, 958				26, 832
Wads		759	3, 505				4, 354
	1, 491	1, 142	28, 553				31, 186
Architectural terra cotta			4, 740				4, 740
Paper:							
Filler	337, 600		548				338, 148
Coating	179, 002						179, 002
	516, 602		548				517, 150
Rubber	59, 588		7, 160				66, 748
Linoleum and oilcloth	4, 058		5, 854				9, 912
Paints:							
Filler or extender	17, 415		248				17, 663
Calcimine	478						478
	17, 893		248				18, 141
Cement manufacture	15, 335	215		3, 280		2, 822, 881	2, 841, 711
Refractories:							
Fire brick and block	92, 897	959	3, 692, 072			5, 155	3, 791, 063
Bauxite, high-alumina brick	140		78, 841				78, 981
Fire-clay mortar, including clay processed for laying							
fire brick	1, 970		211, 359				213, 329
Clay crucibles	3, 318		1, 102				4, 420
Glass refractories	867		15, 818				16, 685
Zinc retorts and condensers			57, 338				57, 338
Foundries and steelworks	4, 651		912, 434	182, 410		21, 094	1, 121, 189
	103, 843	959	4, 968, 964	182, 410		26, 849	5, 283, 025
Heavy clay products: Common brick, face brick, paving brick, drain tile, sewer pipe, and kindred products			1, 097, 554			5, 880, 857	6, 978, 411
Miscellaneous:							
Rotary drilling mud			294	121, 237	29, 049	249, 023	399, 603
Filtering and decolorizing oils (raw and activated earths)				142, 556	202, 375		344, 931
Other filtering and clarifying				1, 264	5, 346		6, 610
Artificial abrasives	6, 205		1, 452			2, 228	9, 885
Asbestos products	3, 010	1, 200				1, 200	5, 410

¹ Figures not comparable with figures published in table on uses in Minerals Yearbook, 1943, because they include captive tonnage of clay burned into clay products or cement at mine.

² Comprises following: Mineral oils, 178,975 tons; vegetable oils, 23,400 tons.

Clay sold or used by producers in the United States in 1944, by kinds and uses, in short tons—Continued

Use	Kaolin	Ball clay	Fire clay and stoneware clay	Bentonite	Fuller's earth	Miscellaneous clay including slip clay	Total
Miscellaneous—Continued							
Chemicals.....	10, 877		113, 004	1, 605			125, 486
Enameling.....		600	350				950
Filler (other than paper or paint).....	2, 737			3, 351	40	13, 450	19, 578
Plaster and plaster products	5, 770					160	5, 930
Concrete admixture, sealing dams.....				1, 097			1, 097
Absorbent uses.....					57, 294		57, 294
Other uses.....	31, 941	3, 088	23, 357	89, 978	633	56, 364	205, 361
	60, 540	4, 888	138, 457	361, 078	294, 737	322, 425	1, 182, 125
Grand total:							
1944.....	873, 056	155, 667	6, 344, 383	546, 768	294, 737	9, 080, 717	17, 295, 328
1943.....	929, 437	147, 785	7, 798, 233	480, 202	247, 258	11, 215, 276	20, 818, 191

¹ Revised figure.

CHINA CLAY OR KAOLIN

Although sales for some uses, such as rubber compounding, have declined, war conditions have not seriously interfered with kaolin production. During the 5-year period 1940-44 output of kaolin in the United States averaged 43 percent higher than in 1935-39. Since 1941 volume has been slowly receding—in 1944 it was 6 percent lower than in 1943.

Georgia furnished 77 percent of the tonnage and South Carolina 14; most of the remaining 9 percent came from North Carolina, Florida, and Pennsylvania.

Although in wartime the consumption of kaolin in paper is limited by the need for the stronger types of paper used in packaging, that industry, as usual, took the lion's share—59 percent of the total in 1944. Refractories consumed 12 percent, pottery 10, and rubber 7; the remaining 12 percent went into a variety of products, such as chemicals, paints, and plasters.

In harmony with the general decline in furnace construction, 30 percent less kaolin was used in refractories in 1944 than in the previous year.

The tonnage of rubber kaolin increased 17 percent, but only minor significance can be attributed to the rise. Synthetic rubber compounding requires large quantities of carbon black in preference to clay-type fillers, and in 1944 a serious shortage of carbon black encouraged the use of more clay than might otherwise have been considered desirable. The future size of the rubber-clay market remains to be determined by research in synthetics and policies governing postwar importation of natural rubber.

Demand for pottery kaolin has been very steady during the past 3 years.

Prices of kaolin changed little during 1944. Crude was quoted as low as \$2.50 per ton, and other grades ranged up to about \$40, depending upon location, degree of preparation, and special qualities. The bulk sells between \$6 and \$15 per ton. In 1944 producers reports showed a national average value of \$9 per ton. Trade journals quoted English china clay from \$19 to \$28 in lump form and \$40 to \$60 air-floated.

Imports of china clay declined 17 percent to 45,890 tons valued at \$487,237 in 1944. Twenty-six tons were reported as coming from Mexico and the remainder from the United Kingdom. Recognizing the equivalent quality of American kaolin, the Army and Navy Munitions Board removed English china clay from the list of strategic raw materials.

The high quality of American kaolin is so widely recognized that English producers are concerned over recapture of their American market. During the war labor and shipping limitations reduced the flow of English china clay to the United States. Although English clay will continue to find a market here, particularly in pottery, the opinion is widely held that its prospects of fully regaining its prewar tonnage are doubtful.

The State totals shown in the accompanying tables on kaolin are directly comparable with those published in Minerals Yearbook, 1943.

Kaolin sold or used by producers in the United States, 1943-44, by States

State	Sold by producer		Used by producer		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1943						
Alabama.....	(1)	(1)			(1)	(1)
California.....	5,687	\$76,956	1,480	\$4,899	7,167	\$81,855
Delaware.....	(1)	(1)			(1)	(1)
Florida.....	(1)	(1)			(1)	(1)
Georgia.....	646,638	5,998,228	85,952	234,344	732,590	6,232,572
Illinois.....	(1)	(1)			(1)	(1)
North Carolina.....	(1)	(1)			(1)	(1)
Pennsylvania.....	20,474	99,650			20,474	99,650
South Carolina.....	112,840	959,933	2,500	2,500	115,340	962,433
Tennessee.....	(1)	(1)			(1)	(1)
Utah.....	(1)	(1)			(1)	(1)
Vermont.....	(1)	(1)			(1)	(1)
Virginia.....	(1)	(1)			(1)	(1)
Undistributed ¹	53,866	690,812			53,866	690,812
	839,505	7,825,579	89,932	241,743	929,437	8,067,322
1944						
Alabama.....	(1)	(1)			(1)	(1)
California.....	6,392	81,440	2,070	6,827	8,462	88,267
Florida.....	(1)	(1)			(1)	(1)
Georgia.....	598,822	5,551,549	75,578	271,875	674,400	5,823,424
Illinois.....	(1)	(1)			(1)	(1)
North Carolina.....	(1)	(1)			(1)	(1)
Pennsylvania.....	15,501	61,245			15,501	61,245
South Carolina.....	118,634	1,068,476			118,634	1,068,476
Utah.....	(1)	(1)			(1)	(1)
Vermont.....	(1)	(1)			(1)	(1)
Virginia.....	(1)	(1)			(1)	(1)
Undistributed ¹	56,059	817,328			56,059	817,328
	795,408	7,580,038	77,648	278,702	873,056	7,858,740

¹Included under "Undistributed."

Figures include States indicated by "(1)" above.

Georgia kaolin sold or used by producers, 1940-44, by uses

Year	China clay, paper clay, etc.			Refractory uses			Total kaolin		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton		Total	Average per ton
1940.....	497,881	\$4,625,080	\$9.29	72,129	\$209,746	\$2.91	570,010	\$4,834,826	\$8.48
1941.....	669,978	6,216,087	9.28	117,035	357,518	3.05	787,013	6,573,605	8.35
1942.....	594,780	5,645,760	9.49	149,628	490,471	3.28	744,408	6,136,231	8.24
1943.....	596,075	5,810,922	9.75	136,515	421,650	3.09	732,590	6,232,572	8.51
1944.....	579,922	5,545,045	9.56	94,478	278,379	2.95	674,400	5,823,424	8.63

BALL CLAY

In 1944 sales of ball clay were 43 percent higher than the average for 1935-39. After setting a record of 198,445 tons in 1941, sales declined in 1942 and 1943, but in 1944 they increased 5 percent. Tennessee furnished slightly over 47 percent of the total and Kentucky slightly under 47 percent. The remaining 6 percent came from Maryland and New Jersey.

In addition to the sales tonnages recorded in the accompanying table, about 6,000 tons used by producers in making heavy clay products was reported as ball clay. Pending definite classification of this material it was tabulated with the miscellaneous clays. As no other captive tonnage was reported, only sales statistics appear in the ball clay table.

Imports of "common blue and ball clays" remained at only a little over half the prewar average—17,097 tons valued at \$157,631 came from the United Kingdom in 1944, and 500 tons valued at \$1,375 were credited to Canada. Consequently, imports satisfied only 10 percent of the ball-clay requirements of the United States in 1944.

Ninety percent of domestic ball-clay output was sold for use in pottery, 6 percent in high grade tile, and the remainder in a variety of uses, such as saggers and refractories. Demand in most uses has been rather erratic since 1941, but pottery requirements have been very stable.

Bulk, shredded ball clay was quoted in trade journals at \$3 to \$7 per ton and air-floated, in bags, from \$10 to \$18.25. The average value reported by producers to the Bureau of Mines in 1944 was \$8.84, slightly higher than the \$8.60 obtained in 1943.

Ball clay sold by producers in the United States, 1942-44, by States

State	1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value
Kentucky.....	80,259	\$696,788	69,982	\$622,309	72,729	\$669,419
Maryland.....	(1)	(1)	(1)	(1)	(1)	(1)
Mississippi.....	(1)	(1)	(1)	(1)	(1)	(1)
Missouri.....	(1)	(1)	(1)	(1)	(1)	(1)
New Jersey.....	(1)	(1)	(1)	(1)	(1)	(1)
Tennessee.....	70,573	606,118	70,606	593,657	73,339	624,297
Undistributed ¹	11,461	75,599	7,197	55,508	9,599	82,380
	162,293	1,378,505	147,785	1,271,474	155,667	1,376,096

¹Included under "Undistributed."

²Includes States indicated by "(1)."

FIRE CLAY

As the war has progressed, consumption of refractories in furnace maintenance has continued at a high level, but with the peak of new furnace construction past, output of fire clay declined 19 percent in 1944.

In recent years the tonnage of fire clay that was burned into clay products at the mine was mentioned only in the text, but this year it is included in the table showing total fire clay sold or used by producers. The relationship between the statistics contained in this and in former

reports is best-illustrated by the year 1943. As shown in the accompanying tables, sales were 2,477,593 tons, shipments for own use elsewhere were 2,223,551 tons, and the quantity burned into products at the mine or pit was 3,097,089 tons. The first two total 4,701,144 tons (the figure appearing as the United States total in Minerals Yearbook, 1943). The last two total 5,320,640 tons (the figure now recorded as "used by producer"). All three total 7,798,233 tons (the figure now recorded as the United States total).

Of the total fire-clay production in 1944 Ohio contributed 25 percent, Pennsylvania 22, Missouri 19, and the remaining 34 percent came from 27 other States. This ranking of Ohio and Missouri is the reverse of that cited in Minerals Yearbook, 1943, owing to the inclusion of the tonnage that is burned into clay products at the mine or pit. A substantial portion of this material is plastic fire clay that is used in making heavy clay products rather than refractories. In 1944 producers in Ohio reported 530,371 tons of fire clay used in heavy clay products, Pennsylvania 167,746, and Missouri only 10,659.

Fire clays have diverse physical and chemical properties that make them useful in the many products shown in the use table, but in 1944 refractories consumed 78 percent and heavy clay products 17.

The average value of fire clay sold on the open market was the same in 1944 as in 1943—\$2.48 per ton. The valuation of the captive tonnage is lower—\$2.08 in 1943 and \$2.12 in 1944—owing to its somewhat lower average quality and lower cost, which influences estimates of values attributed by producers.

Foreign shipments of fire clays have been well-maintained during the war. The United States Department of Commerce reported that exports totaled 87,737 tons valued at \$571,111 in 1944, whereas none was imported.

Fire clay, including stoneware clay,¹ sold or used by producers in the United States, 1943-44, by States

State	Sold by producer		Used by producer ²		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1943						
Alabama.....	102,804	\$171,729	10,639	\$35,275	113,443	\$207,004
Arkansas.....	(³)	(³)	(³)	(³)	126,636	281,189
California.....	326,814	764,375	96,914	178,461	423,728	942,836
Colorado.....	51,276	106,567	41,550	63,092	92,826	169,659
Illinois.....	177,440	321,043	76,644	149,543	254,084	470,586
Indiana.....	50,178	73,110	51,755	65,435	101,933	138,545
Kentucky.....	71,825	291,260	432,008	1,065,624	503,833	1,356,884
Maryland.....	14,318	89,069	101,846	205,493	116,164	294,562
Missouri.....	468,017	1,048,737	1,119,585	1,861,423	1,587,602	2,910,160
New Jersey.....	116,936	672,680	9,593	18,315	126,529	690,995
New Mexico.....	(³)	(³)	(³)	(³)	7,694	14,699
Ohio.....	644,268	1,313,389	1,280,348	2,582,508	1,924,616	3,895,897
Pennsylvania.....	340,353	961,220	1,349,549	3,429,467	1,689,902	4,390,687
Tennessee.....	23,579	100,774			23,579	100,774
Texas.....	1,393	11,837	129,397	224,609	130,700	236,446
Utah.....	(³)	(³)	(³)	(³)	12,794	30,882
Washington.....	7,388	12,690	140,744	157,389	148,132	170,079
West Virginia.....	68,564	138,304	242,451	636,598	311,015	774,902
Other States.....	⁴ 12,440	⁵ 58,316	⁶ 237,617	⁶ 410,114	102,933	141,660
	2,477,593	6,135,100	5,320,640	11,083,346	7,798,233	17,218,446

See footnotes at end of table.

Fire clay, including stoneware clay,¹ sold or used by producers in the United States, 1943-44, by States—Continued

State	Sold by producer		Used by producer ²		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1944						
Alabama.....	(³)	(³)	(³)	(³)	101,265	188,974
Arkansas.....	(³)	(³)	(³)	(³)	84,659	190,161
California.....	226,411	508,922	125,406	178,736	351,817	685,658
Colorado.....	38,054	94,182	37,808	66,910	75,862	161,092
Illinois.....	192,242	275,259	86,678	129,872	278,920	406,131
Indiana.....	58,859	77,142	37,457	61,426	96,316	138,568
Kentucky.....	73,045	293,517	301,532	808,886	374,577	1,102,402
Maryland.....	(³)	(³)	(³)	(³)	96,774	230,459
Missouri.....	275,085	613,226	940,088	1,640,325	1,215,173	2,153,551
New Jersey.....	(³)	(³)	(³)	(³)	101,113	566,220
Ohio.....	535,186	1,139,347	1,062,360	2,167,534	1,597,546	3,306,881
Pennsylvania.....	274,805	784,679	1,104,229	2,604,780	1,379,034	3,589,459
Tennessee.....	(³)	(³)	(³)	(³)	17,163	91,275
Texas.....	(³)	(³)	(³)	(³)	104,771	299,808
Utah.....	(³)	(³)	(³)	(³)	10,415	28,091
Washington.....	7,008	11,701	65,029	107,819	72,037	119,520
West Virginia.....	64,545	132,136	251,573	681,945	316,118	814,084
Other States.....	⁴ 222,446	⁴ 946,856	⁴ 364,537	⁴ 743,919	70,823	97,787
	1,967,686	4,876,967	4,376,697	9,290,151	6,344,383	14,167,118

¹ Includes stoneware clay as follows—1943: 156,307 tons, \$214,228; 1944: 70,385 tons, \$113,894.

² Comprises—1943: Shipments for own use elsewhere, 2,223,551 tons, \$5,034,822; burned into clay products at mine or pit (estimated) 3,097,089 tons, \$6,048,524. 1944—shipments for own use elsewhere, 1,836,718 tons, \$4,188,492; burned at mine or pit by producer (estimated), 2,539,979 tons, \$5,101,659.

³ Included under "Other States."

⁴ Includes diaspore and burley clay as follows—1943: Diaspore, 58,299 tons, \$359,435; burley, 76,857 tons, \$245,426; 1944: Diaspore, 46,659 tons, \$301,356; burley, 60,775 tons, \$152,626.

⁵ Figures cover States indicated by "(³)" above and—1943: Idaho, Iowa, Massachusetts, Minnesota, Montana, Nebraska, Nevada, North Dakota, Oregon, South Carolina, and Virginia; 1944: Idaho, Massachusetts, Minnesota, Montana, Nebraska, New Mexico, North Dakota, Oregon, South Carolina, and Virginia.

⁶ Figures cover States indicated by "(³)" above and—1943: Idaho, Iowa, Michigan, Minnesota, Montana, Nebraska, Nevada, North Dakota, Oregon, and South Carolina; 1944: Delaware, Georgia, Idaho, Massachusetts, Michigan, Minnesota, Nebraska, Nevada, New Mexico, North Carolina, North Dakota, Oregon, and South Carolina.

Fire clay, including stoneware clay, shipped by producers in the United States, 1940-44

Year	Sales		Shipped for own use elsewhere		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	1,639,335	\$4,676,799	1,125,912	\$2,369,947	2,765,247	\$7,046,746
1941.....	2,455,145	6,578,408	1,712,422	3,609,325	4,167,567	10,187,733
1942.....	2,649,295	6,339,888	2,190,037	5,041,618	4,839,332	11,381,506
1943.....	2,477,593	6,135,100	2,223,551	5,034,822	4,701,144	11,169,922
1944.....	1,967,686	4,876,967	1,836,718	4,188,492	3,804,404	9,065,459

BENTONITE

In 1944 bentonite production increased 14 percent to over one-half million tons and for the sixth consecutive year established a new record.

Although consumption in nearly all uses was well-maintained, the principal expansion was in rotary drilling mud. Bentonite owes its growth in this market not only to the increase in the number of holes drilled but also to the greater average depth and to the relatively higher proportion of holes drilled with rotary rather than cable equipment. Consequently, whereas in 1944 about one-third more oil wells were drilled than in 1943, 76 percent more bentonite was consumed in drilling mud.

Wyoming and South Dakota were the principal beneficiaries of the expansion; decreases were reported in several States. Wyoming supplied 36 and South Dakota 31 percent of the total output.

As production capacity was ample to meet demand the War Production Board did not find allocation necessary. However, a shortage of railroad cars in the West seriously impeded deliveries from time to time, and the assistance of Government agencies was required to maintain a uniform flow of shipments.

Mine-run bentonite may be valued as low as \$2 a ton. Trade journals quoted dried and crushed, f. o. b. mines, at \$7.50; pulverized,

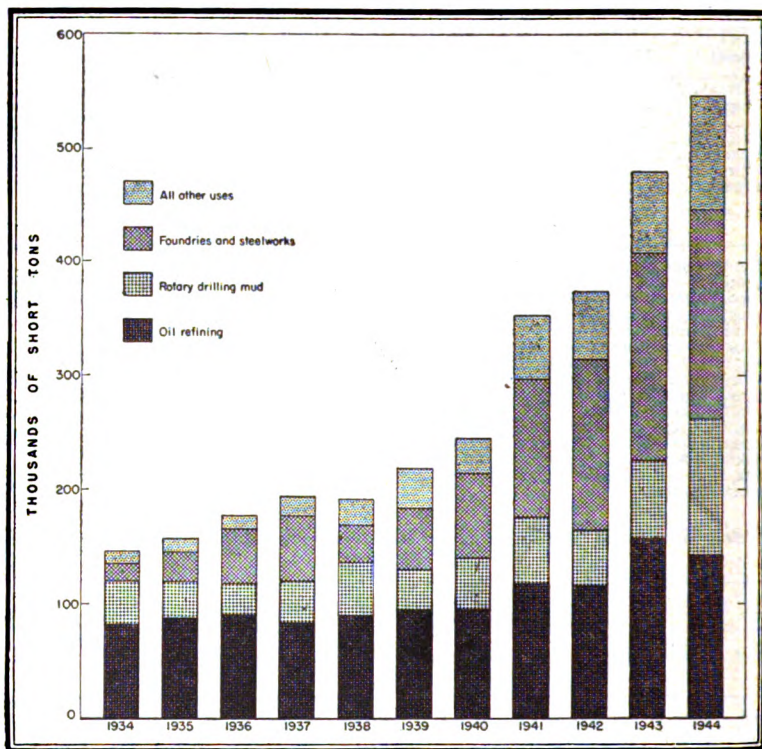


FIGURE 1.—Bentonite sold or used by domestic producers for specified uses, 1934—44.

200-mesh, \$9.50 to \$11; and 325-mesh, bagged, at \$16. Owing to the sale of a larger proportion of higher-priced grades the average value reported by producers increased from \$6.24 per ton in 1943 to \$6.60 in 1944.

The United States Department of Commerce reports that no bentonite was imported in 1944. Exports are not separately listed, but producers reported to the Bureau of Mines that they shipped 19,925 tons to Canada, Mexico, South America, Portugal, India, and Australia. This figure does not include some foreign shipments by dealers, nor does it include acid-treated bentonite exported for oil refining.

The State totals in the accompanying table are directly comparable with those published in previous years.

Bentonite sold or used by producers in the United States, 1943-44, by States

State	Sold by producer		Used by producer		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1943						
Arizona.....	(1)	(1)	(1)	(1)	(1)	(1)
California.....	(1)	(1)	(1)	(1)	7, 104	\$65, 205
Mississippi.....	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota.....	124, 528	\$822, 264	(1)	(1)	124, 528	822, 264
Texas.....	(1)	(1)	(1)	(1)	25, 078	187, 981
Utah.....	(1)	(1)	(1)	(1)	(1)	(1)
Wyoming.....	159, 252	1, 399, 644	(1)	(1)	159, 252	1, 399, 644
Undistributed ¹	69, 328	436, 491	127, 094	\$349, 355	164, 240	532, 660
	353, 108	2, 648, 399	127, 094	349, 355	480, 202	2, 997, 754
1944						
Arizona.....	(1)	(1)	(1)	(1)	(1)	(1)
California.....	(1)	(1)	(1)	(1)	6, 649	60, 404
Mississippi.....	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota.....	169, 893	1, 104, 919	(1)	(1)	169, 893	1, 104, 919
Texas.....	(1)	(1)	(1)	(1)	24, 081	216, 861
Utah.....	(1)	(1)	(1)	(1)	(1)	(1)
Wyoming.....	196, 138	1, 711, 193	(1)	(1)	196, 138	1, 711, 193
Undistributed ¹	87, 606	531, 023	93, 131	258, 853	150, 007	512, 611
	453, 637	3, 347, 135	93, 131	258, 853	546, 768	3, 605, 988

¹ Included under "Undistributed."² Figures include States indicated by "(1)."**FULLER'S EARTH**

The rapid recovery in the production of fuller's earth is continuing.

Owing to heavy competition from activated earths and synthetic substitutes fuller's earth lost ground steadily after 1930. By 1940 output had declined to 146,568 tons, but by 1944 it had risen to more than double that figure. Wartime demands for petroleum products, shortages of competitive materials, and new absorbent uses have all contributed to the recovery that has nearly reached record levels. Only in 1929 and 1930 has volume been greater. In 1944 output was 19 percent greater than in 1943.

Producers reported that 61 percent was consumed in mineral-oil refining, 8 percent for vegetable oils, and 31 percent for various applications such as in rotary drilling mud, in foundries, as an absorbent of grease on floors, and for other filtering and clarifying.

Although the Georgia-Florida district produced 44 percent of the total tonnage, Texas, with 38 percent, had the largest output of any individual State.

Only minor price increases were allowed by the Office of Price Administration in 1944. Trade journals quoted domestic fuller's earth from \$7 to \$15 per ton in bags, and imported from \$30 to \$40. These prices indicate the general range of valuation, although some special products exceed them, and some cruder materials are sold for less than \$7 per ton. The average value rose from \$10.77 in 1943 to \$11.19 in 1944. Material from Georgia-Florida was valued at \$14.25 per ton, from Illinois at \$9.23, and from Texas at \$8.24.

Only 308 tons of fuller's earth valued at \$4,284 were imported in 1944—all from the United Kingdom. Exports are not separately recorded by the United States Department of Commerce, but producers reported to the Bureau of Mines that they sent 7,459 tons valued at \$76,344 to Canada, the Persian Gulf, and South America, slightly more than the 6,842 tons reported for 1943.

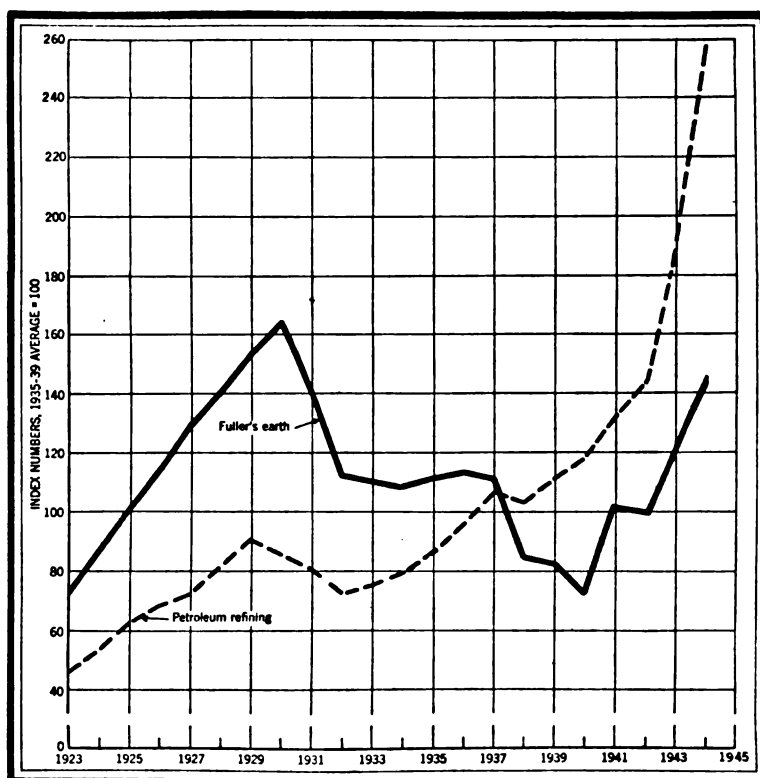


FIGURE 2.—Mine shipments of fuller's earth compared with petroleum-refining activity (Federal Reserve Board Index), 1923-44.

As sales and consumption of fuller's earth by producers cannot be published without revealing the figures of individual companies only totals are shown in the accompanying table.

Fuller's earth sold or used by producers in the United States, 1942-44, by States

State	1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value
Florida and Georgia.....	83,007	\$1,091,062	105,647	\$1,444,936	128,654	\$1,833,682
Illinois.....	30,421	264,611	¹ 39,500	¹ 372,024	42,277	390,346
Texas.....	85,012	712,303	94,137	728,141	111,212	916,159
Other States ²	5,804	71,694	7,974	118,926	12,594	156,877
	204,244	2,139,670	¹ 247,258	¹ 2,664,027	294,737	3,297,064

¹ Revised figure.

² Comprises following States: California, Colorado (1942), Nevada, Tennessee (1943-44), and Utah.

MISCELLANEOUS CLAYS

Clays vary so widely in their properties that it is usually very difficult to arrive at a generally accepted definition for each class. Kaolin, bentonite, and other types discussed separately in this chapter have widely, though by no means universally, recognized character-

istics. There remain a few clays of limited use, such as slip clay, and a great tonnage of other clays and shales used principally to make structural clay products. These are treated as a group in this section.

As most of this material is used in making heavy clay products and cement its value is low. A few specialties like slip clay and drilling mud range up to and over \$10 per ton, but the bulk is worth less than \$1 per ton. As comparatively little is sold as raw clay its valuation is largely an attributed market value estimated from known production costs.

For the reasons outlined at the beginning of this chapter the statistics in the accompanying table cover all miscellaneous clay output reported to the Bureau of Mines rather than only the portion that is shipped before use.

Owing to a substantial decline in cement manufacture and a moderate reduction in shipments of clay products, output of miscellaneous clays in 1944 was 19 percent lower than in 1943.

Miscellaneous clays, including slip clay and shale, sold or used by producers in the United States, 1943-44, by States

State	Sold by producer ¹		Used by producer ²		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1943						
Alabama.....	(³)	(³)	(³)	(³)	526, 469	\$311, 070
Arkansas.....	(³)	(³)	(³)	(³)	125, 017	78, 465
California.....	153, 628	\$455, 960	695, 111	\$416, 310	848, 739	872, 270
Colorado.....	14, 287	17, 813	133, 324	69, 047	147, 611	86, 860
Georgia.....	(³)	(³)	(³)	(³)	482, 570	325, 763
Illinois.....	15, 786	45, 981	840, 985	535, 098	856, 771	581, 079
Indiana.....	42, 903	22, 627	221, 719	127, 375	264, 622	150, 002
Iowa.....	7, 770	28, 767	418, 160	242, 764	425, 930	271, 531
Kansas.....	(³)	(³)	(³)	(³)	462, 406	255, 052
Kentucky.....	(³)	(³)	(³)	(³)	104, 782	64, 121
Louisiana.....	(³)	(³)	(³)	(³)	78, 647	61, 162
Maryland.....	(³)	(³)	(³)	(³)	200, 556	120, 531
Massachusetts.....	(³)	(³)	(³)	(³)	73, 276	48, 264
Michigan.....	(³)	(³)	(³)	(³)	625, 458	367, 721
Mississippi.....	(³)	(³)	(³)	(³)	51, 137	43, 292
Missouri.....	9, 823	11, 704	315, 637	166, 715	325, 460	178, 419
Montana.....	(³)	(³)	11, 020	6, 264	11, 020	6, 264
Nebraska.....	(³)	(³)	(³)	(³)	47, 167	36, 946
New Jersey.....	(³)	(³)	116, 113	57, 413	116, 113	57, 413
New York.....	(³)	(³)	(³)	(³)	307, 908	225, 584
North Carolina.....	(³)	(³)	419, 728	272, 823	419, 728	272, 823
Ohio.....	(³)	(³)	982, 354	598, 830	982, 354	598, 830
Oklahoma.....	(³)	(³)	(³)	(³)	270, 640	164, 610
Oregon.....	(³)	(³)	(³)	(³)	108, 562	62, 369
Pennsylvania.....	68, 087	42, 101	872, 807	560, 224	940, 894	602, 325
South Carolina.....	(³)	(³)	190, 990	124, 144	190, 990	124, 144
South Dakota.....	(³)	(³)	39, 710	20, 245	39, 710	20, 245
Tennessee.....	(³)	(³)	(³)	(³)	397, 174	251, 622
Texas.....	85, 720	229, 849	750, 613	446, 829	836, 333	676, 678
Utah.....	(³)	(³)	30, 735	50, 126	50, 126	30, 735
Virginia.....	(³)	(³)	248, 952	147, 988	248, 952	147, 988
Washington.....	(³)	(³)	(³)	(³)	168, 050	99, 984
West Virginia.....	(³)	(³)	(³)	(³)	139, 050	81, 547
Wisconsin.....	(³)	(³)	(³)	(³)	54, 344	32, 076
Wyoming.....	(³)	(³)	7, 736	5, 028	7, 736	5, 028
Undistributed ⁴	277, 531	279, 390	4, 224, 656	2, 523, 931	278, 974	173, 142
	675, 535	1, 134, 192	10, 539, 741	6, 351, 763	11, 215, 276	7, 485, 955
1944						
Alabama.....	(³)	(³)	(³)	(³)	456, 488	277, 063
Arizona.....	(³)	(³)	48, 805	31, 723	48, 805	31, 723
Arkansas.....	(³)	(³)	116, 562	76, 461	116, 562	76, 461
California.....	220, 079	645, 058	594, 070	358, 137	814, 149	1, 003, 195
Colorado.....	(³)	(³)	(³)	(³)	123, 939	74, 475
Connecticut.....	(³)	(³)	55, 480	36, 062	55, 480	36, 062
Georgia.....	(³)	(³)	(³)	(³)	450, 032	300, 464
Illinois.....	(³)	(³)	(³)	(³)	741, 882	509, 017

See footnotes at end of table.

Miscellaneous clays, including slip clay and shale, sold or used by producers in the United States, 1943-44, by States—Continued

State	Sold by producer ¹		Used by producer ²		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1944—Continued						
Indiana	25,482	\$13,549	195,714	\$115,869	221,196	\$129,418
Iowa	3,705	31,373	482,228	283,747	485,933	315,121
Kansas	(³)	(³)	(³)	(³)	251,240	135,057
Kentucky	(³)	(³)	(³)	(³)	63,520	39,760
Louisiana	(³)	(³)	(³)	(³)	48,491	56,109
Maryland	(³)	(³)	(³)	(³)	172,059	105,758
Massachusetts			58,843	38,248	58,843	38,248
Michigan	(³)	(³)	(³)	(³)	502,114	294,494
Mississippi	(³)	(³)	(³)	(³)	48,872	44,341
Missouri	(³)	(³)	(³)	(³)	233,657	126,306
Montana			16,166	10,508	16,166	10,508
Nebraska	(³)	(³)	(³)	(³)	21,925	16,469
New Jersey	(³)	(³)	(³)	(³)	97,154	63,194
New York	(³)	(³)	(³)	(³)	254,588	176,541
North Carolina			349,659	222,828	349,659	222,828
Ohio	(³)	(³)	(³)	(³)	743,764	462,194
Oklahoma	(³)	(³)	(³)	(³)	174,253	100,010
Oregon			66,787	38,294	66,787	38,294
Pennsylvania	(³)	(³)	(³)	(³)	784,042	503,163
South Carolina			204,703	159,608	204,703	159,608
South Dakota			42,633	22,112	42,633	22,112
Tennessee	(³)	(³)	(³)	(³)	230,768	189,772
Texas	(³)	(³)	(³)	(³)	498,022	587,759
Utah			44,621	46,616	44,621	46,616
Virginia			182,814	107,441	182,814	107,441
Washington			157,012	96,261	157,012	96,261
West Virginia	(³)	(³)	(³)	(³)	70,744	40,134
Wisconsin	(³)	(³)	(³)	(³)	58,714	33,304
Wyoming			6,069	3,945	6,069	3,945
Undistributed ⁴	352,708	633,787	5,856,577	3,578,642	123,017	74,435
	601,974	1,323,767	8,478,743	5,226,502	9,080,717	6,550,269

¹ Includes following—1943: slip clay from Michigan and New York, 5,386 tons \$47,386; 1944: 2,831 tons, \$25,322. Purchases of common clay and shale by cement companies—1943: 381,360 tons, \$190,678; 1944: 259,218 tons, \$129,006.

² Comprises following: Shipments for own use elsewhere—1943, 353,794 tons, \$274,343; 1944, 293,271 tons, \$294,948. Common clay and shale burned into clay products at mine or pit—1943: 6,562,991 tons, \$4,265,944 (estimated); 1944: 5,621,809 tons, \$3,649,724 (estimated). Common clay and shale used by producer in cement manufacture—1943: 3,622,956 tons, \$1,811,476 (estimated); 1944: 2,563,663 tons, \$1,281,830 (estimated).

³ Included under "Undistributed."

⁴ Figures include States indicated by "(³)" and Arizona (1943 only), Delaware, District of Columbia, Florida, Idaho, Maine, Minnesota, New Hampshire (1943 only), New Mexico, North Dakota, Puerto Rico, and Vermont.

CLAY PRODUCTS

The structural clay products industry was depressed in 1944. War construction and private building furnished a meager demand. As in 1943, low volume and high labor and material costs plagued operators, and nearly half of them had either shut down completely or were shipping from inventory. Many said that their output was limited by labor shortages and price problems. In several areas the Office of Price Administration permitted modest price increases.

On the other hand, anticipation of a postwar building boom lightened the atmosphere, and producers were urged to modernize their plants and methods and prepare themselves for future high production.

During the war, production of art pottery has increased owing to interruption of imports, and shortages of competitive articles.

The accompanying chart, drawn from information furnished by the War Production Board, shows the contraction in output and inventories of unglazed brick during the war.

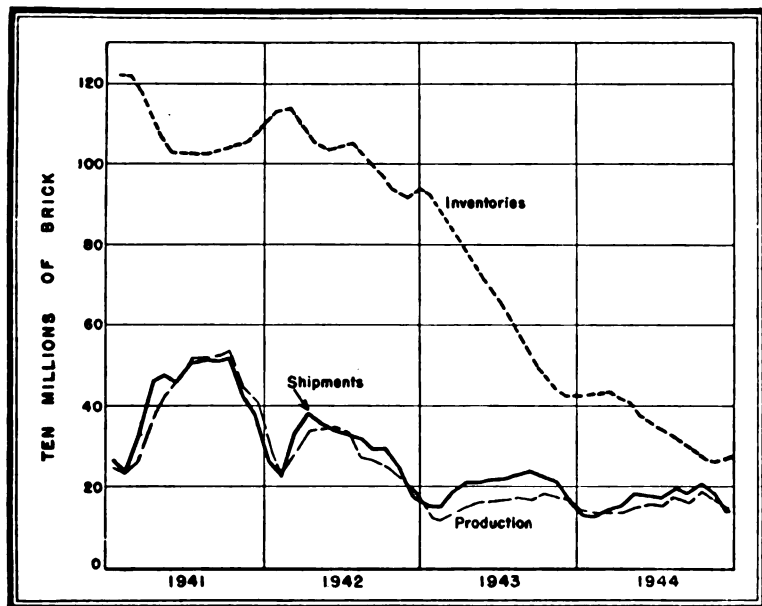


FIGURE 3.—Production, shipments, and inventories of unglazed brick, 1941-44.

TECHNOLOGIC DEVELOPMENTS

To prepare their companies to meet future opportunities and competition, progressive operators are improving their plants and products. Better heat insulation, easier placement, acoustical insulation, modern appearance, and even radiant heating are some of the advantages claimed for various structural shapes. A step toward relatively lower building costs is the modular design that is strongly advocated by trade and technical associations. In the modular system, design is based on a 4-inch module or increment which enables the producer to offer shapes that will fit at the building site without wasteful cutting and fitting, an objective believed to be of particular value in brick and tile construction.

As tunnel kilns are not always more economical than periodic kilns many companies hesitate to install them. For such organizations, installation of highly mechanized small tunnel units was suggested as a means of gradually converting without disturbing production.² Thus over a period of time there would be accumulated a battery of small units that could be operated near capacity without losing flexibility to the market demands for a variety of products. Tunnel kilns are strongly advocated because they lend themselves to mechanization which reduces labor costs and breakage. It has been predicted that over 100 tunnel kilns will be installed after the war.³

² Isenhour, John H., Improvements and Future Plans for Tunnel Kilns: Bull. Am. Ceram. Soc., vol. 23, No. 9, Sept. 15, 1944, pp. 327-329.

³ Brick and Clay Record, Can You Afford Not To Install Tunnel Kilns: Vol. 104, No. 5, May 1944, pp. 17-20.

As a war measure, sponge iron is being produced in brick kilns. Alternate layers of iron ore and anthracite are put in saggars (flue tile) and burned at ordinary brick temperatures.⁴

A description of a method for rapid identification of clays, by differential thermal analysis, was published in 1944.⁵

Closer coordination between producers and consumers of refractories is enabling better refractories to be developed as they can be tested for performance under service conditions during development. With a clear picture of the commercial specifications that must be met, producers can set up adequate inspection and control systems. On the other hand, complete testing in service is too slow for an aggressive development program so there is a constant urge for new and more rapid tests. The Panel Spalling test revealed the virtues of superduty brick. X-ray and microscopic analyses now often displace the slower chemical analysis.⁶

A description of the effects of addition of clay and shale to mortar was published in 1944.⁷

Although naval attacks on our bauxite supply lines had been successfully repulsed by 1944, hope was retained that clay would prove its value as an ore of aluminum. Construction continued on the two plants that propose to produce alumina from clay. By the year end the lime-sinter-process plant of the Ancor Corp. at Harleyville, S. C., had started experimental production, and construction of the ammonium sulfate process plant of the Columbia Metals Corp. at Salem, Oreg., was well advanced.

⁴ Walker, J. P., Reduction of Iron Ore in Clay and Steel Containers (Saggars): Bureau of Mines Rept. of Investigations 3819, 1945, 30 pp.

Ross, Donald W., Production of Sponge Iron in a Shale-Brick Plant: Bureau of Mines Rept. of Investigations 3822, 1945, 27, pp.

Brick and Clay Record, vol. 104, No. 4, April 1944, p. 17.

⁵ Grim R. E., and Rowland R. A., Differential Thermal Analysis of Clays and Shales, A Control and Prospecting Method: Jour. Am. Ceram. Soc., vol. 27, No. 3, Mar. 1, 1944, pp. 65-76.

⁶ Harvey, F. A., and Birch R. E., Testing Refractories: Brick and Clay Record, vol. 104, No. 4, April 1944, p. 39.

⁷ Hursh, R. K., Lamar J. E., and Grim, R. E., Illinois Clays and Shales as Mortar Mix: Illinois State Geol. Survey Rept. of Investigations 100, 1944, 55 pp.

ABRASIVE MATERIALS

By **ROBERT W. METCALF AND A. B. CADE**

SUMMARY OUTLINE

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GENERAL CONDITIONS

The output of the abrasives industries in 1944 totaled 1,340,909 short tons valued at \$34,403,056 and was only slightly under that of the industrially active year 1943. Domestic production of natural abrasives in 1944 amounted to 954,505 short tons valued at \$9,575,038, or 71 and 28 percent of the total tonnage and value, respectively, of all abrasives for which data are included in this chapter. The output of artificial abrasives in 1944 continued at a high level and was only 6 percent below that in 1943, the record year for these products. Ground sand and sandstone and metallic abrasives rose to new highs. Average annual sales of diatomite for the 3-year period 1942-44 were substantially higher than for similar periods heretofore reported. Marketed production of emery, pumice and pumicite, and tripoli were larger than in 1943. Domestic production of most of the other natural abrasive products herein discussed was somewhat less in 1944 than in 1943.

The total value of imports of natural abrasives in 1944 rose to \$23,456,221, or 4 percent greater than in 1943. Imports of bort (glazier's and engraver's diamonds, unset and miner's) again broke all records, and the continued tendency to use smaller industrial stones also was reflected in the decline in average value per carat to \$1.79. In 1944 this classification comprised about 96 percent of the total value of imported materials. Corundum imports were the highest on record, although receipt of diamond dust in 1944 dropped to less than half that reported for 1943. Imports of pumice, garnet, and tripoli in 1944 were very small. The total value of exports of abrasives and abrasive products in 1944 decreased 41 percent compared with 1943, owing chiefly to the sharply reduced export value of emery and corundum abrasive wheels.

This chapter includes data for most of the materials used chiefly as abrasives, although certain clays, oxides, and substances mentioned later under Miscellaneous Mineral Abrasive Materials are not included in the statistics presented herein. On the other hand, certain of the abrasive materials for which figures are shown also have important nonabrasive uses.

Salient statistics of the abrasives industries in the United States, 1943-44

	1943		1944		Percent of change in 1944	
	Short tons	Value	Short tons	Value	Short tons	Value
Natural abrasives:						
Domestic production (sold or used by producers):						
Distomite.....	174,957	\$3,298,178	174,957	\$3,298,178	-----	-----
Tripoli.....	14,912	244,365	18,425	301,863	+23.6	+23.6
Quartz.....	99,445	346,558	82,379	286,478	-17.2	-17.1
Ground sand and sandstone.....	541,350	3,937,452	558,606	2,989,981	+3.2	+1.3
Grindstones.....	10,732	392,296	9,373	356,106	-12.7	-9.2
Pulstones.....	1,891	95,909	(¹)	(¹)	-----	-----
Oilstones and related products.....	(¹)	(¹)	(¹)	(¹)	-----	-----
Millstones.....	(¹)	9,240	(¹)	9,700	-----	+5.0
Tube mill linings.....	2,585	46,071	2,063	38,833	-20.2	-15.7
Grinding pebbles.....	9,924	157,778	8,012	172,418	-19.3	+9.3
Pumice and pumicite.....	85,150	611,495	88,757	704,110	+4.2	+15.1
Garnet.....	5,935	429,120	(¹)	(¹)	-----	-----
Corundum.....	(¹)	(¹)	(¹)	(¹)	-----	-----
Emery.....	6,666	63,195	6,940	64,858	+4.1	+2.6
Total natural abrasives ¹.....	953,547	9,631,657	954,505	9,575,038	+1	-6
Artificial abrasives:						
Silicon carbide—production ¹	69,706	5,912,590	56,291	4,717,675	-19.2	-20.2
Aluminum oxide—production ¹	217,425	13,202,270	185,573	11,668,838	-14.6	-11.6
Metallic abrasives (steel shot and grit)—shipments.....	124,954	7,083,141	144,540	8,441,505	+15.7	+19.2
Total artificial abrasives.....	412,085	26,198,001	386,404	24,828,018	-6.2	-5.2
Total abrasives.....	1,365,632	35,829,658	1,340,909	34,403,056	-1.8	-4.0
Foreign trade:						
Imports.....	(¹)	22,565,161	(¹)	23,456,221	-----	+3.9
Exports.....	(¹)	3,550,528	(¹)	2,091,066	-----	-41.1

¹ Average annual figure for 1942-44. Accumulated total production for 3-year period 1942-44 was 524,877 tons, \$9,894,534.

² Data included in total; Bureau of Mines not at liberty to publish figures.

³ Data for oilstones and related products and corundum not included in totals; Bureau of Mines not at liberty to publish figures.

⁴ Tonnage of millstones not recorded.

⁵ Includes Canadian production.

⁶ Weight cannot be reported because of varying units.

POSTWAR PROSPECTS

The abrasives industry follows to a large extent fluctuations of the automobile and the so-called heavy industries. The military and naval armament and accessory equipment all require cutting, grinding, and smoothing or polishing and thus need abrasives either as loose grain, or in bonded or coated products of many different types. The contract obligations of most of the industries supplying these articles of war have not decreased materially with cessation of the war in Europe. Although perhaps a sizable demand will continue, eventually the greater part of this market will cease. Reconversion to civilian economy and to manufacture of durable goods for civilian consumption should result in a demand for abrasives. The increased

production of automobiles and the pent-up need for new railroad and industrial equipment also should contribute to a healthy demand for abrasive products in the postwar era.

The expected activity in construction of private and public buildings will be accompanied by the greater use of insulating materials. This will tend to stimulate nonabrasive outlets of diatomite and to a less extent of pumice. The wider acceptance of lightweight aggregates and lightweight concrete in construction also may increase diatomite and pumice sales.

Predicted new uses and new methods of tooling will produce far-reaching changes in the efficiency and the technique of processing diamonds and the ease and speed of operation.

NATURAL SILICA ABRASIVES

Diatomite.—The Bureau of Mines has not been at liberty to publish annual production statistics since 1926. Total output (sales) for 3-year periods, however, may be shown. Total sales for the three most recent such periods were as follows: 1942–44, 524,872 short tons valued at \$9,894,534; 1939–41, 360,502 tons valued at \$5,746,216; and 1936–38, 279,645 tons valued at \$4,377,353. The totals for the 1942–44 period are the highest yet reached and indicate record outputs in recent years for this product.

The principal producing States in 1944 as for many years, were California and Oregon. No sales were reported in 1944 for Florida or New Mexico. Other production came from the same additional States as in 1943—Idaho, Nevada, New York, and Washington.

Statistics of uses cannot be shown. It is possible, however, to indicate certain relationships and in general to report certain changes in trends of shipments. The principal uses for diatomite are for filtration, insulation, and fillers, with small tonnages for fine abrasives such as silver polish. Filtration, which generally consumes slightly over half the total output, rose to nearly 60 percent. Amounts used as fillers also increased, totaling about one-fifth of total sales. Other or miscellaneous uses were higher than in 1943. The figures reported for insulation in 1944, however, were somewhat less than in 1943, probably in large part because of the smaller output of refractories and steel in 1944 and the continued inactivity of the construction industries.

Quotations on diatomite in 1944 remained at the same levels as in 1943 and were reported in E&MJ Metal and Mineral Markets as follows (prices are per ton on a f. o. b. mill, Nevada, basis): Crude, in bulk, dried, \$7, nominal; 98- to 100-mesh, \$20; low-temperature insulation, \$19; high-temperature insulation, \$30; fine abrasive, 2 cents per pound. (Bags extra.) In February 1945 these quotations were changed as follows: Crude, in bulk, dried, \$10 per ton; 98- to 100-mesh, \$25; low-temperature insulation, \$25; high-temperature insulation, \$40; fine abrasive, 2 to 3 cents per pound. (Bags extra.) In March 1945 a quotation on filtration grades of diatomite in California was added: \$20 to \$50 per ton, f. o. b. mill.

The unusual properties of diatomaceous earth as a filter-aid have resulted in its extensive employment in pressure filters especially where the impurities are viscous or colloidal in character, as in the

filtration of oils, sugar, syrups, or cereal beverages.¹ A vitally important application of the filter-aid properties of diatomite is the development of portable high-rate pressure-type filtration equipment for the use of the armed forces in the field.²

Chesters,³ in a discussion of minerals and other substances used in steel-plant insulation, described the characteristics and properties of diatomite as an insulating medium in this field, both as natural sawed shapes and in the form of bricks of raw or calcined material. The preparation and use of diatomite (and other products) in high-temperature heat insulation and the application of heat-resistant materials to various types of ferrous and nonferrous foundries and to open-hearth furnaces were studied by Paterson.⁴

Ammonium nitrate, which is one of the cheapest known fertilizer materials, is extremely hygroscopic and tends to cake in storage. To counteract these unfavorable characteristics, granulation and coating of the resultant granules with a wax, followed by dusting with an inert mineral powder, are resorted to.⁵ A number of dusting agents have been used, including kaolin, limestone, diatomaceous earth, plaster of paris, and tricalcium phosphate. Extensive tests by the United States Department of Agriculture⁶ have indicated that diatomaceous earth is one of the most satisfactory conditioning materials available. Its use, it is claimed, promotes a free-flowing product and makes possible easy handling and spreading in the field, whether by hand or in standard drilling equipment. Also it tends to prevent caking, even after long periods of storage. Commercial use of diatomite as a dusting agent apparently is more prevalent in Canada than in the United States and has been reported by at least three Canadian firms manufacturing chemicals and fertilizers.

Tripoli.—Output of tripoli in 1944 increased 24 percent in both quantity and value compared with 1943, although considerably under other recent years. Production in Illinois, the only State for which data may be shown, was 18 percent higher than in 1943. Other States that produced in 1944 were Arkansas, Missouri, Oklahoma, and Pennsylvania (rottenstone).

The principal uses of tripoli are as abrasives—chiefly as constituents of polishing and buffing compounds—and as fillers. Tonnages reported sold for use as abrasives more than doubled in 1944 compared with 1943, and the quantity reported sold for fillers was about half the 1943 total. Concrete admixtures, foundry facing, and oil-well drilling mud were among the other uses specified.

¹ Chemical Age (London), Filter Aids—Applications of Diatomaceous Earth: Vol. 51, No. 1317, Sept. 23, 1944, p. 298.

² Black, Hayse H., and Spaulding, C. H., Diatomite Water Filtration Developed for Field Troops: Jour. Am. Water Works Ass., vol. 26, November 1944, pp. 1208-1221; Water Works and Sewerage, vol. 91, No. 8, August 1944, p. 284 (abs.).

³ Holberg, H. E., Diatomaceous Filtration: Water Works and Sewerage, vol. 91, No. 11, November 1944, p. 392 (abs.).

⁴ Science News Letter, vol. 47, No. 21, May 26, 1945, p. 328.

⁵ Chesters, J. H., Insulation of Steel Plant Equipment: Iron Age, vol. 154, No. 8, Aug. 24, 1944, pp. 42-49.

⁶ Paterson, G. W., High-Temperature Heat Insulation: Trans. American Foundrymen's Ass., vol. 52, No. 3, March 1945, pp. 927-944.

⁷ Whittaker, C. W., and Mehring, A. L., Nitrogenous Fertilizers for Direct Application: Reprint from Fertilizer Rev., October-November-December, 1943.

⁸ Ross, William H., Adams, J. Richard, Yee, J. Y., and Whittaker, Colin H., Preparation of Ammonium Nitrate for Fertilizer Use: Reprint from Ind. Eng. Chem., vol. 36, No. 12, December 1944, pp. 1088-1095.

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1940-44

Year	Illinois		Other States ¹		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	11,521	\$155,576	18,691	\$210,993	30,212	\$366,569
1941.....	13,833	200,700	15,468	221,046	29,301	421,746
1942.....	12,575	203,390	4,961	69,038	17,536	272,428
1943.....	10,203	168,758	4,709	75,607	14,912	244,365
1944.....	12,031	205,732	6,394	96,131	18,425	301,863

¹ 1940-41: Arkansas, California, Missouri, Oklahoma, Pennsylvania, and Texas; 1942 and 1944: Arkansas, Missouri, and Pennsylvania; 1943: Arkansas, Missouri, Oklahoma, and Pennsylvania.

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1942-44, by uses

Use	1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasives.....	5,447	\$85,013	6,146	\$101,248	13,218	\$210,592
Concrete admixture.....	754	8,895	335	4,690	316	4,552
Filler.....	8,887	144,055	6,894	114,929	3,423	66,147
Oil-well drilling.....	(1)	(1)	.....	.....	(1)	(1)
Other uses ²	2,448	34,465	1,537	23,498	1,468	20,572
	17,536	272,428	14,912	244,365	18,425	301,863

¹ Included under "Other uses."

² 1942 and 1944: Foundry facing, drilling mud, and unspecified; 1943: Filter block, foundry facing and unspecified.

As reported by E&MJ Metal and Mineral Markets, quotations on tripoli during 1944 remained at the same level as in other recent years (prices are per short ton, f. o. b. Missouri, in paper-lined burlap bags, minimum carlot 30 tons): Once-ground, through 40-mesh, rose- or cream-colored, \$14.50; double-ground, through 110-mesh, rose or cream, \$16; air-floated, through 200-mesh, \$26. Quotations on rottenstone, as given in Oil, Paint and Drug Reporter, were unchanged throughout 1944, as follows (prices are at mines, in bags): Carlots, \$25.50 per short ton; and less than carlots, \$37.50 per ton.

Firms actively producing tripoli in 1944 were: Arkansas—Corona Products, Inc., Rogers; Illinois (amorphous silica)—Olive Branch Minerals Co., Cairo, and Ozark Minerals Co., Cairo; Missouri and Oklahoma—Barnsdell Tripoli Corp., Seneca, Mo.; Missouri—Independent Gravel Co., Joplin; and Pennsylvania (rottenstone)—Penn Paint & Filler Co., Antes Fort, and Keystone Filler & Mfg. Co., Muncy.

Quartz.—Sales of crude, crushed, and ground quartz from pegmatite veins or dikes and from quartzite in 1944 were 17 percent less than in 1943 in both quantity and value. The total crude quartz sold in 1944 rose nearly 150 percent compared with 1943. A large drop in output of crushed quartz and a sizable decrease in reported sales of ground material were the chief factors in the over-all decline. Total sales in 1944, however, were higher than in any recent year other than 1943, although the average value per ton in 1943 and 1944 remained the same (\$3.48).

Quartz (crude, crushed, and ground)¹ sold or used by producers in the United States, 1940-44

Year	Crude		Crushed		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	3,606	\$17,099	17,652	\$58,897	10,807	\$100,394	31,865	\$176,390
1941.....	8,977	39,247	24,101	94,913	8,607	94,427	41,685	228,567
1942.....	2,043	7,937	45,747	144,808	18,088	178,749	65,878	331,494
1943.....	6,134	55,600	84,233	183,507	9,078	107,451	99,445	346,558
1944.....	15,222	35,279	61,823	170,325	5,334	80,874	82,379	286,478

¹ To avoid duplication, the ground material shown here is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.

Eleven States reported sales of quartz in 1944, the same number as in 1943. The greater part of the output came from Western States and can be accounted for largely by the expanded ferrosilicon program in the Pacific Coast area. No production in 1944 was listed from Massachusetts, Ohio, Pennsylvania, or Texas.

Quotations on ground "hard quartz" silica, as reported by Oil, Paint and Drug Reporter at the beginning of 1944, were as follows: 325-mesh (99½-percent grade), carlots in bags, \$13.50 per ton, and less than carlots, \$18.50; 140-mesh (99½-percent grade), carlots in bags, \$11 per ton, and less than carlots \$16. These quotations remained unchanged throughout 1944, and the early months of 1945, except that carlots of 325-mesh material rose to \$15.50 in March 1944.

Quartz (crude, crushed, and ground)¹ sold or used by producers in the United States, 1942-44, by States

State	1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value
Arizona.....	(?)	(?)	(?)	(?)	67,109	\$206,477
California.....	(?)	(?)	(?)	(?)		
Oregon.....	(?)	(?)	(?)	(?)		
Washington.....	(?)	(?)	(?)	(?)	88	203
Maine.....	364	\$922	140	\$840		
Maryland.....	(?)	(?)	827	12,737		
Massachusetts.....	1,029	8,137	1,037	7,259	(?)	(?)
New Jersey.....	975	8,649	(?)	(?)	(?)	(?)
Ohio.....						
Pennsylvania.....						
North Carolina.....	(?)	(?)	8,684	84,530	(?)	(?)
Tennessee.....	(?)	(?)			(?)	(?)
Virginia.....	(?)	(?)			75	303
Texas.....	319	3,190				
Other States ²	63,191	310,596	88,757	241,192	15,107	79,495
	65,878	331,494	99,445	346,558	82,379	286,478

¹ To avoid duplication, the ground material included is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.

² Included under "Other States."

³ 1942: Arizona, California, Maryland, New York, North Carolina, Tennessee, Virginia, Washington, and Wisconsin; 1943: Arizona, California, New Jersey, Washington, and Wisconsin; 1944: Maryland, New Jersey, North Carolina, Tennessee, and Wisconsin.

Ground sand and sandstone.—Sales of ground sand and sandstone in 1944 rose 3 percent in quantity and 1 percent in value compared with 1943 and totaled 558,606 short tons valued at \$3,989,981, a new high in both tonnage and value. Production each year since 1938 has been larger than in the preceding year. Output by States or groups of States, for which comparable data are presented, for the

most part indicated small decreases in 1944 compared with 1943, although production for Ohio, Virginia, and West Virginia combined was slightly larger than in 1943. Outputs for California-Washington and for "Other States" in 1944 also increased compared with 1943 data. States producing sizable tonnages of ground sand and sandstone are Illinois, New Jersey, Ohio, and Pennsylvania.

Ground sand and sandstone sold or used by producers in the United States, 1940-44

Year	Short tons	Value	Year	Short tons	Value
1940.....	342, 218	\$2, 088, 314	1943.....	541, 350	\$3, 937, 452
1941.....	487, 665	3, 073, 730	1944.....	558, 606	3, 989, 981
1942.....	527, 886	3, 646, 643			

Ground sand and sandstone sold or used by producers in the United States, 1942-44, by States

State	1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value
California.....	8, 371	\$68, 324	{ ⁽¹⁾ 3, 902	{ ⁽¹⁾ \$25, 485	20, 872	\$208, 925
Washington.....						
Georgia.....	300	3, 008	3, 252	32, 525	3, 090	19, 823
Illinois.....	158, 853	1, 087, 481	164, 401	1, 180, 469	158, 673	1, 098, 275
Massachusetts.....	2, 761	13, 948	3, 148	16, 050	2, 500	12, 000
New Jersey and Pennsylvania.....	188, 598	1, 143, 746	179, 634	1, 119, 640	173, 551	1, 139, 818
Ohio, Virginia, and West Virginia.....	149, 625	1, 167, 207	152, 142	1, 259, 977	152, 514	1, 182, 255
Other States ¹	19, 378	162, 929	34, 871	303, 306	47, 406	328, 885
	527, 886	3, 646, 643	541, 350	3, 937, 452	558, 606	3, 989, 981

¹ Included under "Other States."

² 1942: Missouri and Wisconsin; 1943: California, Missouri, North Carolina, and Wisconsin; 1944: Louisiana, Missouri, North Carolina, and Wisconsin.

Distribution of sales of ground sand and sandstone by uses, as reported by firms producing 91 percent of the total sales, indicates that the principal customers for these products are the manufacturers of pottery, porcelain, and tile, foundry operators, and users of abrasives, particularly cleaning and scouring compounds, in order of size of shipments. Manufacture of glass and enamel and consumers of various types of fillers account for most of the remaining tonnage for which uses are reported.

Ground sand and sandstone sold or used by producers in the United States in 1944, by uses¹

Use	Short tons	Value	
		Total	Average per ton
Abrasive:			
Cleansing and scouring compound.....	72, 770	\$421, 763	\$5.80
Other.....	538	11, 019	20.40
Enamel.....	17, 591	134, 007	7.62
Filler.....	11, 556	136, 161	11.78
Foundry.....	105, 798	730, 769	6.91
Glass.....	48, 878	299, 855	6.13
Pottery, porcelain, and tile.....	173, 183	1, 380, 187	7.97
Other uses.....	76, 722	515, 229	6.73
Total reported by uses.....	507, 036	3, 628, 990	7.16

¹ Data represent 91 percent of the industry.

Abrasive sands.—Natural sands with a high silica content are employed for sand blasting, stone polishing, glass grinding, coating sandpaper, or other abrasive purposes. Total sales of such grinding and polishing sand in 1944 amounted to 897,983 short tons valued at \$1,563,511, compared with 837,662 tons valued at \$1,428,463 in 1943—an increase of 7 percent in tonnage and 9 percent in value. In 1944 these data included 482,293 tons of blast sand valued at \$1,228,744 and in 1943, 450,997 tons valued at \$1,138,003.

SPECIAL SILICA-STONE PRODUCTS

Grindstones and pulpstones.—Production of grindstones in 1944 decreased 13 percent in quantity and 9 percent in value compared with 1943 and was the lowest output since 1940. Sales of pulpstones also were less in 1944 than in 1943. Actual data, however, may not be published. As in most recent years, grindstones were produced in Ohio and West Virginia. Output of pulpstones was reported only from West Virginia.

Grindstones and pulpstones sold by producers in the United States, 1940-44

Year	Grindstones		Pulpstones		
			Quantity		Value
	Short tons	Value	Pieces	Equivalent short tons	
1940.....	8,790	\$284,809	901	4,533	\$211,639
1941.....	13,573	434,208	685	1,963	111,348
1942.....	12,763	422,763	528	1,918	116,976
1943.....	10,732	392,296	323	1,891	95,909
1944.....	9,373	356,106	(¹)	(¹)	(¹)

¹ Bureau of Mines not at liberty to publish figures.

Oilstones and related products.—Sales of natural sharpening stones, including oilstones, whetstones, scythestones and rubbing stones, were slightly higher in 1944 than in 1943. The Bureau of Mines, however, has not been at liberty to publish sales figures since 1939. States that produced in 1944 and the type of stone reported from each State were as follows: Arkansas—oilstones and whetstones; Indiana—rubbing stones; New Hampshire—scythestones; and Ohio—scythestones, whetstones, and “other” sharpening stones, including lathestones.

Millstones.—The value of sales of millstones in 1944 increased 5 percent, to \$9,700, compared with \$9,240 in 1943. Output, as in 1943, was reported from Ulster County, N. Y., Rowan County, N. C., and Montgomery County, Va.

*Value of millstones and chasers sold by producers in the United States, 1940-44*¹

Year	Producers	Value	Year	Producers	Value
1940.....	5	\$6,558	1943.....	4	\$9,240
1941.....	8	15,579	1944.....	3	9,700
1942.....	5	10,391			

¹ 1940 and 1942-44: Includes sales from New York, North Carolina, and Virginia; 1941: Sales from New York, North Carolina, Virginia, and West Virginia.

Grinding pebbles and tube-mill liners.—Total sales of grinding pebbles and tube-mill liners in 1944 declined 19 percent in quantity, and the total value rose 4 percent compared with 1943. Sales of grinding pebbles were 19 percent less than in 1943. Tube-mill liners in 1944 decreased 20 percent, although the average realization was somewhat larger. The Bureau of Mines has not been free to publish totals for grinding pebbles and tube-mill liners from 1933 to 1940, inclusive.

Grinding pebbles and tube-mill liners sold or used by producers in the United States; 1941-44

Year	Grinding pebbles		Tube-mill liners		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1941.....	13, 561	\$22, 826	3, 411	\$54, 216	16, 972	\$276, 042
1942.....	15, 487	245, 794	2, 576	49, 967	18, 063	295, 761
1943.....	9, 924	157, 778	2, 585	46, 071	12, 509	203, 849
1944.....	8, 012	172, 418	2, 063	38, 833	10, 075	211, 251

Grinding pebbles were produced in six States in 1944—California, Minnesota, North Carolina, Texas, Washington, and Wisconsin, and tube-mill liners were reported from three States—Minnesota, North Carolina, and Wisconsin.

John T. Momand, Carlsbad, Calif., reported sales of beach pebbles in 1944. Quartzite liners and artificially rounded quartzite grinding pebbles were prepared by Jasper Stone Co., Sioux City, Iowa, from quarries at Jasper, Minn. Southern Products & Silica Co., Lilesville, N. C., produces Texas flint pebbles at its plant at Glidden, Tex., and mills and markets silica (quartz) pebbles from deposits at Lilesville, N. C. Some of the crude Texas pebbles also are processed at Lilesville. Harris Granite Quarries Co., Salisbury, N. C., and Peeler & McCombs, Faith, N. C., both sold rounded granite cubes and granite liners in 1944. Dezendorf Marble Co., Austin, Tex., shipped some flint pebbles, and Mineral Products Co., Seattle, Wash., sold grinding pebbles from Stevens County, Wash. Quartzite pebbles and liners also were marketed by Baraboo Quartzite Co., Baraboo, Wis.

The search for grinding pebbles in this country after cessation of European imports at the outbreak of World War II led to the development of the Texas flint-pebble deposits. The part played in this search by the Southern Products & Silica Co. was briefly reviewed, and the flint-pebble operations at this company's mills at Glidden, Tex., and Lilesville, N. C., were described by Trauffer.⁷ In connection with the possibility of foreign competition now that the European phase of the war is over, it is understood from correspondence received by the senior author that importation of French and Danish pebbles cannot be expected in substantial quantity for some time, as the coastal areas in the regions of the pebble deposits were heavily mined and must be cleared before the pebbles can be gathered.

NATURAL SILICATE ABRASIVES

Pumice and pumicite.—Output of pumice and pumicite in 1944 increased 4 percent in tonnage and 15 percent in value compared with

⁷ Trauffer, W. E., Grinding Pebbles from Texas Help to Supply Demand as Imports Cease: Pit and Quarry, vol. 37, No. 3, September 1944, pp. 80-81.

1943, although it was still considerably under the high levels of 1941 and 1942. However, sales in 1944 were larger than in any year previous to 1941.

Production was reported in seven States in 1944, the same number as in 1943—output was listed from Oregon in 1944 and none was reported from Oklahoma. The principal producing States, as in 1943, were Kansas and California. The value of production in Kansas in 1944 did not change materially, although that in California rose 23 percent in quantity and 53 percent in value.

Pumice and pumicite sold or used by producers in the United States, 1940-44

Year	Short tons	Value	Year	Short tons	Value
1940.....	82,407	\$499,914	1943.....	85,150	\$611,495
1941.....	117,310	669,514	1944.....	88,757	704,110
1942.....	126,522	706,199			

Pumice and pumicite sold or used by producers in the United States, 1942-44 by States

State	1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value
California.....	74,925	\$206,424	25,490	\$160,441	31,409	\$245,898
Kansas.....	36,810	139,930	43,918	163,366	43,034	163,538
Nebraska.....	6,837	47,194	(¹)	(¹)	6,083	51,043
New Mexico.....	7,396	294,331	4,837	202,558	(¹)	(¹)
Oklahoma.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Oregon.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Texas.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Washington.....			700	7,362	783	8,705
Undistributed ²	554	18,320	10,205	77,768	7,448	234,926
	126,522	706,199	85,150	611,495	88,757	704,110

¹ Included under "Undistributed."

² Includes States indicated by "(¹)."

Abrasive manufacture remained the largest use of pumice and pumicite in 1944 and accounted for about 72 percent of total sales. (See fig. 1.) Cleansing and scouring compounds and hand soaps showed a small decrease in tonnage and a slight increase in value. Pumice and pumicite sold for other abrasive use increased in both quantity and value. Although private construction activity continued at a comparatively low level, sales of pumice and pumicite for use in concrete admixture and concrete aggregate in 1944 were somewhat above 1943 figures and were responsible almost entirely for the increased quantity of total sales of these products in 1944. Sales for acoustic plaster again decreased sharply compared with the previous year. "Other uses" gained slightly in tonnage in 1944 compared with 1943 and included, in 1944, sales for use in insecticides, insulation, brick manufacture, filtration, and solvents.

Experiments using pumice as a flux in the smelting of iron sand were reported from New Zealand.⁸ Corrosion of the clay crucibles used was considerable. Quotations on pumice as reported by E&MJ Metal & Mineral Markets during 1944 and the early part of 1945 were as follows: F. o. b. New York or Chicago, in barrels, powdered—2¼ @ 4½ cents per lb., and lump—5@7½ cents per lb.

⁸ Donovan, W., Possible Use of Pumice in Smelting New Zealand Iron Sand; *New Zealand Jour. Sci. Tech.*, 26 B, 1944, pp. 159-61 (see G. A. Hayter, *New Zealand Patent* 44,346); *Chem. Abs.*, vol. 39, No. 6, Mar. 20, 1945, p. 1122.

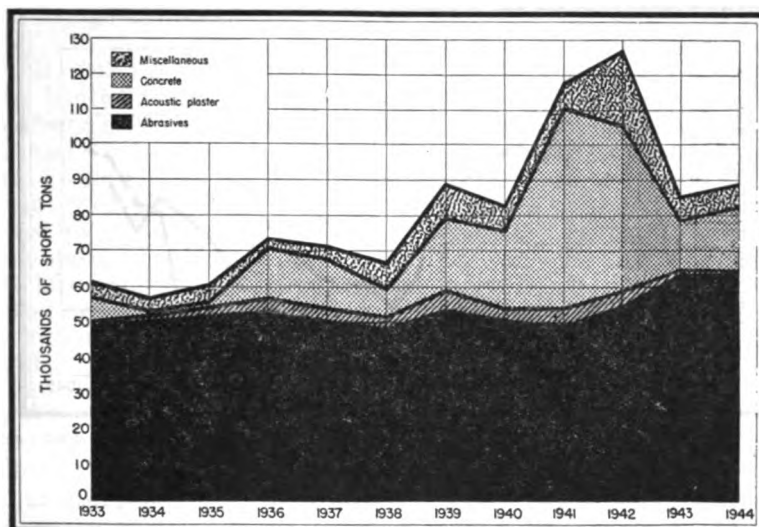


FIGURE 1.—Trends, by uses, of pumice and pumicite sold or used by producers in the United States, 1933-44

Pumice and pumicite sold or used by producers in the United States, 1942-44 by uses

Use	1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasive:						
Cleansing and scouring compounds and hand soaps.....	50,324	\$353,788	59,247	\$354,242	57,833	\$375,310
Other abrasive uses.....	4,084	90,286	4,216	64,988	6,004	136,753
Acoustic plaster.....	4,552	121,551	1,617	29,860	938	29,144
Concrete admixture and concrete aggregate.....	46,183	57,219	13,794	52,718	17,511	90,136
Other uses ¹	21,399	83,355	6,276	109,687	6,381	72,767
	126,522	706,199	85,150	611,495	88,757	704,110

¹ 1942: Asphalt, insulation, insecticide, paint products, filtration, and unspecified; 1943: Asphalt, insecticide, paint filler, brick manufacture, filtration, solvents, and unspecified; 1944: Insecticide, insulation, brick manufacture, filtration, solvents, and unspecified.

Garnet.—Sales of abrasive garnet in 1944 were somewhat less than in 1943, although the Bureau of Mines is not at liberty to publish production data. The trend of garnet production before 1944 is shown in figure 2. Output of garnet in 1944 was reported from Idaho and New York. Two companies were active near Fernwood, Idaho—Spokane Garnet Sand & Sales Co., and Garnet Mines, Inc., both with offices in Spokane, Wash. Barton Mines Corp., North Creek, was producing in New York. According to the trade press, the latter firm has recently installed equipment to prepare superfine garnet flour which has been used to supplement shortages of corundum superfines in the precision grinding of optical glass.⁹

Quotations on domestic garnet in 1944 as reported by E&MJ Metal & Mineral Markets were unchanged from previous listings: New York Adirondack garnet concentrates, grain—\$85 per short ton. Quotations on Spanish garnet were discontinued.

⁹ Pit and Quarry, vol. 37, No. 10, April 1945, p. 59.

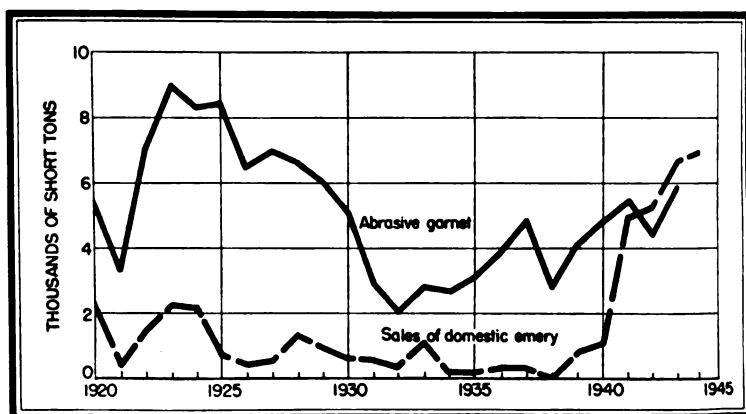


FIGURE 2.—Marketed production in the United States of abrasive garnet, 1920-43, and domestic emery, 1920-44

Abrasive garnet sold or used by purchasers in the United States, 1940-44

Year	Short tons	Value	Year	Short tons	Value
1940.....	4,716	\$259,345	1943.....	5,935	\$429,120
1941.....	5,501	371,752	1944.....	(¹)	(¹)
1942.....	4,357	299,904			

¹ Bureau of Mines not at liberty to publish figures.

Grinding to -35-mesh (25 percent minus 200-mesh), desliming, and flotation in the presence of a fatty acid and a small amount of sulfuric acid effected a satisfactory recovery of garnet (and kyanite) on an ore containing 8 percent garnet, 13 percent kyanite, 30 percent mica, and 45 percent quartz and feldspar plus minor amounts of other constituents.¹⁰ A recent patent for a new synthetic abrasive product described the sintering of garnet and aluminum oxide at a temperature of 1,500° C. or higher, causing a fusion of the garnet and agglomeration of the Al_2O_3 fines.¹¹ The resultant abrasive granules after cooling, grinding, and sizing are said to have a hardness of 8 or greater (Mohs' scale) and can be bonded by the commonly used bonding materials.

NATURAL ALUMINA ABRASIVES

Corundum.—Corundum, a natural alumina abrasive, Al_2O_3 , has been especially in demand for use in the manufacture of grinding or snagging wheels essential to heavy industry (particularly to those firms manufacturing heavy equipment for the armed forces) and also is employed as an important polishing agent for vitally necessary precision lenses. The coarser grain sizes are purchased by the snagging-wheel manufacturers and the finer-sized products by optical-lens makers. The fine dust, with its admixed minute particles of glass, is

¹⁰ Falconer, S. A., and Crawford, B. D., Froth Flotation of Some Nonsulphide Minerals of Strategic Importance: Am. Inst. Min. and Met. Eng. Tech. Pub. 1754, 1944. 16 pp.

¹¹ Brown, John A. (assigned to Minnesota Mining & Manufacturing Co.), Abrasive Material: U. S. Patent 2,358,313, Sept. 19, 1944; Chem. Abs., vol. 39, No. 7, Apr. 10, 1945, p. 1522.

sold to retail opticians, both in this country and in many parts of the world.

Until 1943 no production of natural corundum had been reported in the United States since 1917 and 1918 and none previous to those years since 1906. Although a small output of corundum was made in 1943 and 1944 for test purposes, this project has now been discontinued. Activity in North Carolina and Montana at the end of 1944 had not progressed beyond experimental stages.

Most of the corundum used in this country for many years has been obtained from the Union of South Africa, which in most normal years has maintained a fairly steady supply, despite distance of market and transportation difficulties. In the last year or so, however, production has not kept pace with demand, and efforts in the Union and plans of the Foreign Economic Administration to secure wider and better exploitation have not achieved the desired results. The opening of new deposits and improved mining and concentrating methods would be of great benefit to this South African industry.¹² Shipments from the Union of South Africa in 1943, which were smaller than in 1942, continued at approximately the same rate through the first half of 1944, at least, yet were considered insufficient to meet the strong demand, particularly from the United States.¹³ Supplementing the corundum from the Union of South Africa, shipments of small quantities from other countries have occasionally been received, including material recovered from old tailings dumps.

A general discussion of corundum appeared late in 1944.¹⁴

Prices on crude corundum imported into the United States do not appear in domestic trade journals. However, quotations on prepared sizes of natural corundum, as given in E&MJ Metal & Mineral Markets, beginning in March 1944, were as follows: Per pound, sizes 8 to 60, incl., 8½ cents; 70 to 275, incl., 9½ cents; 500, 30 cents; 850, 45 cents; 1,000, 45 cents; 1,200 to 1,600, 65 cents; and 2,600, 70 cents.

Ceramic materials as substitutes for tool steel in gages present interesting postwar possibilities. Plug gages of 85 or 90 percent corundum-base composition have gaged 350,000 steel cartridge cases with the same degree of wear as tool-steel gages after only 15,000 cases.¹⁵ Other types of ceramic gages also were described. Laboratory flotation tests on a 3-percent corundum ore were described by Falconer and Crawford.¹⁶ In order to achieve best results it was necessary to thoroughly deslime the flotation feed. A 54-percent concentrate and an additional 8 percent in tailings were obtained with a high percentage recovery of corundum. Flotation was rapid, and the consumption of reagents was not excessive.

Emery.—Sales of domestic emery in 1944 increased 4 percent in quantity and 3 percent in value compared with 1943 (see fig. 2) and reached 6,940 short tons valued at \$64,858—the highest figure since 1918. The entire output, as in former years, was mined in the Peekskill, N. Y., region. The chief uses of emery are in abrasive products,

¹² South African Mining and Engineering Journal, vol. 55, part II, No. 2700, Nov. 4, 1944, p. 225.

¹³ South African Mining and Engineering Journal, Natural and Artificial Abrasives—Their Characteristics and Uses: Vol. 55, pt. II, No. 2710, Jan. 20, 1945, p. 487.

¹⁴ Metcalf, Robert W., Corundum: Bureau of Mines Inf. Circ. 7295, 1944, 18 pp.

¹⁵ Twells, Robert, Ceramic Gages of Abrasion-resisting Compositions: Bull. Am. Ceram. Soc., vol. 23, No. 11, Nov. 15, 1944, pp. 408-411.

¹⁶ Falconer, S. A., and Crawford, B. D., Froth Flotation of Some Nonsulfide Minerals of Strategic Importance: Am. Inst. Mining and Met. Engrs. Tech. Pub. 1754, 1944, 16 pp.

such as grinding wheels, sticks, and polishing compositions, and as a nonslip, wear-resistant ingredient in concrete floors. According to E&MJ Metal and Mineral Markets, crude domestic emery ore was quoted in 1944 at the same price as in 1943: \$10 per ton for first-grade material, f. o. b. New York. Quotations on grain emery in 1944, also appearing in E&MJ Metal and Mineral Markets, were as follows (prices are per pound, in 350-lb. kegs, f. o. b. Pennsylvania): Turkish and Naxos, 7 cents; Khasia, 6 cents; American, 5 cents.

Emery sold or used by producers in the United States, 1940-44

Year	Short tons	Value	Year	Short tons	Value
1940.....	1,046	\$9,349	1943.....	6,666	\$63,195
1941.....	4,876	42,484	1944.....	6,940	64,858
1942.....	5,277	49,413			

NATURAL CARBON ABRASIVES¹⁷

Industrial diamonds are produced largely in the Belgian Congo, and a large proportion of the rest of the world production comes from Gold Coast, Sierra Leone, and Angola. Record sales of industrials in 1943 totaled about £6,000,000. Sales have exceeded output in recent years, the value of 1943 sales being over twice that of present production. Since stocks are low and skilled sorters are few due to the war, 1944 sales, although undoubtedly at a high level, were expected to be somewhat smaller than in 1943. The exceptionally active market reflects the dependence of industrial production, civilian and military—with its closer tolerances, large-scale methods and tougher, harder alloys—upon the abrasive (and abrasion-resistant) qualities of the diamond. To provide a reserve for emergency use outside the Union of South Africa, a substantial quantity of industrial grades has been transferred to Canada,¹⁸ where they may be drawn upon, when needed, both by that country (Canada) and the United States, whose industries consume by far the greater share of the world sales.

An excellent summary of all phases of the diamond industry—production, marketing, consumption, industrial and gem—appeared in 1944.¹⁹ A comparison of the abrasive properties of the diamond with other natural and manufactured abrasive materials included, in tabular form, structural and physical properties of many of the more commonly used abrasives.²⁰ The establishment of a large diamond-cutting industry for fine-size diamonds in the United States following invasion of the Low Countries, the revolutionary application of machinery and assembly-line methods to cutting operations, and the probable development of new uses for diamonds in postwar industry were discussed by Walker.²¹ Uses and description of diamonds, and the applications in industry of diamond dust and drilling, shaped,

¹⁷ See also chapter on Gem Stones of this volume.

¹⁸ Mining Journal (London), Record Diamond Sales: Annual Review Number, 1944, Apr. 5, 1944, p. 48.
¹⁹ Ball, Sydney H., The Diamond Industry in 1943; Reprint from Jewelers' Circular-Keystone, 1944, 24 pp.

²⁰ Industrial Diamond Review, Properties of Hard Abrasives: I. D. R. Data Sheet 2, vol. 4, No. 39, February 1944, p. 37.

²¹ Walker, Lester C., Diamonds Discover America: Nation's Business, vol. 32, No. 6, June 1944, pp. 40, 42, 44.

natural, and die stones were presented by Rockwell.²² Detailed descriptions of diamond deposits in Bolivia,²³ Gold Coast,²⁴ South-West Africa,²⁵ northeastern Angola,²⁶ and the Ural Mountains in U. S. S. R.²⁷ were published.

ARTIFICIAL ABRASIVES

Total production of artificial abrasives in 1944 aggregated 386,404 short tons, valued at \$24,828,018, or 6 percent less in tonnage and 5 percent less in value than in 1943. The combined total, however, of these manufactured abrasive products—silicon carbide, aluminum oxide, and metallic abrasives (steel shot and grit)—was larger than in any year except 1943. Production of silicon carbide in 1944 decreased 19 percent in quantity and 20 percent in value compared with 1943, this decline approximating the drop in used capacity—98 percent in 1943 and 78 percent in 1944. The output of aluminum oxide in 1944 was 15 percent under 1943 and similarly reflected operation considerably under capacity—79 percent in 1944 compared with 98 percent in 1943. Shipments of metallic abrasives (steel shot and grit) rose in 1944 to a new record in both quantity and value—144,540 short tons valued at \$8,441,505, or 16 percent higher in tonnage and 19 percent higher in value than in the previous peak year (1943). Operation was at 75 percent of capacity.

A compilation of data on stocks and capacity, as reported by the producers, shows variations in inventories and capacity over a period of years.

Crude artificial abrasives sold, shipped, or used, from manufacturing plants in the United States and Canada, 1940-44

Year	Silicon carbide ¹		Aluminum oxide ¹		Metallic abrasives ²		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940	33,042	\$2,359,876	98,531	\$5,464,986	50,016	\$2,317,829	181,589	\$10,142,691
1941	44,962	3,325,928	147,759	9,067,732	86,309	4,050,659	279,030	16,444,319
1942	61,681	4,904,309	183,633	12,719,337	106,442	5,618,913	351,756	23,242,559
1943	69,706	5,912,590	217,425	13,202,270	124,954	7,083,141	412,085	26,198,001
1944	56,291	4,717,675	185,573	11,668,838	144,540	8,441,505	386,404	24,828,018

¹ Production; Bureau of Mines not at liberty to publish data for United States separately. Figures include material used for refractories and other nonabrasive purposes.

² Figures include only shipments from United States plants.

Production of silicon carbide and aluminum oxide largely is concentrated in the Niagara Falls region of Canada and the United States; some aluminum oxide, however, is produced in Quebec, Canada, and in Alabama. The same companies that produced aluminum oxide and silicon carbide in 1943 and other recent years were active in 1944. The total for aluminum oxide in 1944 included 25,868 short tons of "white high-purity or special" material, valued

²² Rockwell, F. G., *Industrial Diamonds: Min. and Met.*, vol. 25, No. 449, May 1944, p. 257-259.

²³ *The Mining Magazine*, *Diamonds in Bolivia*: vol. 70, No. 3, Mar. 1944, pp. 189-190.

²⁴ Junner, N. R., *Diamond Deposits of the Gold Coast*: *Min. Jour.*, Apr. 1, 1944, pp. 189-192.

²⁵ *South African Mining and Engineering Journal*, *Minerals of South-West Africa*: Vol. 55, No. 2681, June 24, 1944, p. 387.

²⁶ Ray, Horatio C., *Lundu Diamond District of Angola: Rocks and Minerals*, vol. 19, No. 6, June 1944, p. 179.

²⁷ *Mining Journal*, *Diamond Production in the U. S. S. R.*: Vol. 222, No. 5690, Sept. 8, 1944, p. 546.

at \$2,847,167—a decrease of 8 percent in quantity and 11 percent in value compared with 1943. Silicon carbide consumed in refractory or nonabrasive uses in 1944 was estimated at 43 percent of total production compared with 41 percent in 1943 and 35 percent in 1942. Similar data for aluminum oxide indicate only a small percentage of total output employed for nonabrasive or refractory purposes—3 percent in 1944, 4 percent in 1944 and 3 percent in 1942.

Stocks and capacity, as reported by producers of artificial abrasives, 1935-44, in short tons

Year	Silicon carbide		Aluminum oxide		Metallic abrasives	
	Stocks at end of year	Capacity	Stocks at end of year	Capacity	Stocks at end of year	Capacity
1935.....	8,037	(¹)	22,932	(¹)	2,390	(¹)
1936.....	6,613	(¹)	14,101	(¹)	2,198	(¹)
1937.....	6,074	(¹)	17,966	(¹)	3,012	(¹)
1938.....	12,568	(¹)	32,121	(¹)	4,944	(¹)
1939.....	7,475	(¹)	21,528	(¹)	4,389	(¹)
1940.....	3,621	(¹)	18,372	(¹)	5,042	(¹)
1941.....	2,640	44,960	19,546	150,146	3,708	136,730
1942.....	4,806	61,681	20,707	179,214	4,278	142,026
1943.....	9,384	70,938	28,360	222,602	2,524	169,500
1944.....	8,916	71,850	32,402	234,000	3,388	191,289

¹ Data not available.

Statistics for metallic abrasives cover steel shot and grit (including figures for one firm that manufactures a similar product from salvaged wire clippings) but not steel wool. In 1944, metallic abrasives were manufactured in Massachusetts, Michigan, New Hampshire, New York, Ohio, and Pennsylvania. The principal producing States, in order of production, were Ohio, Michigan, and Pennsylvania. Thirteen companies with 14 plants reported shipments in 1944, compared with 12 companies and 13 plants in 1943. A new plant in the Chicago area was beginning regular production early in 1945, and another firm was said to be planning erection of a plant in 1945 to manufacture abrasives in the same general region.

Producers of metallic abrasives in 1944 were the following:

Western Metal Abrasive Co., 2545 East 79th St., Cleveland 4, Ohio—plant at Chicago Heights, Ill. (production in 1945).

Holden & Norris, Inc., Wilmington, Mass.

Industrial Metal Abrasives Co., 1603 Wildwood Ave., Jackson, Mich.

Cleveland Metal Abrasive Co., 887 East 67th St., Cleveland 8, Ohio—plant at Howell, Mich.

Clayton-Sherman Abrasive Co., 3896 Lanyo Road, Detroit 10, Mich.

Harrison Abrasive Corp., 887 Chestnut St., Manchester, N. H.

Abrasive Shot & Grit Co., 1 Carolina St., Springville, N. Y.

American Steel Abrasives Co., Sherman, East and Charles Sts., Galion, Ohio.

Cleveland Metal Abrasive Co., 887 East 67th St., Cleveland 8, Ohio—plant at Cleveland.

National Metal Abrasive Co., 3560 Norton Road, Cleveland 11, Ohio.

Steelblast Abrasives Co., 6536-40 Carnegie Ave., Cleveland, Ohio.

Cut Steel Abrasives, Inc., 1609 Wilson Ave., Youngstown, Ohio.

Globe Steel Abrasive Co., 238 First Ave., Mansfield, Ohio.

Pittsburgh Crushed Steel Co., 4839 Harrison St., Pittsburgh, Pa.

Philadelphia Steel Abrasive Co., Vandalia and McKean Sts., Philadelphia 48, Pa.

Electrochemical and similar industries in the Niagara Falls region were described and their products enumerated in a 1944 release.²⁸ An account of the historical development and growth of the Exolon Co., Tonawanda, N. Y., one of the manufacturers of silicon carbide and fused aluminum oxide appeared early in 1945.²⁹ Properties and uses of silicon carbide were discussed.³⁰ Russian tests recently reported in Ceramic Abstracts³¹ indicate that the efficiency of boron carbide may be 40 to 70 percent of that of diamond dust.

Bombarding metal surfaces with steel shot not only improves surface finish, thereby reducing need for further polishing, but makes such surfaces distinctly more resistant to destructive corrosion and actually increases fatigue strength.³² More effective with thin work pieces, this so-called "shot peening" is applicable to irregular shapes or to specific areas and reduces costs materially.

MISCELLANEOUS MINERAL ABRASIVE MATERIALS

In addition to the natural and manufactured abrasive materials discussed herein, many other mineral substances are used for abrasive purposes. Various oxides, including tin oxide, rouge, crocus, chromium oxide, magnesium oxide and manganese oxide, are utilized as polishing agents. Preparation of cerium oxide as an abrasive in polishing glass has been developed recently in Canadian plants and adopted by many United States firms. Ceria is more efficient and cleaner in action and effects a saving of 30 to 60 percent in polishing time, which more than offsets its higher cost.³³ Among manufactured or artificially prepared products used or intended for use as abrasives may be mentioned boron carbide and a periclase abrasive made from magnesite. Finely ground or calcined clays, high-grade lime, talc, feldspar, river silt, slate flour, whiting, and other substances also have specialized abrasive applications.

FOREIGN TRADE³⁴

The total value of imports of abrasive materials in 1944 increased about 4 percent over 1943. This increase was due almost entirely to a 4-percent rise in imports of bort (glaziers' and engravers' diamonds, unset, and miners'), this classification comprising largely what are known as industrial diamonds. Reflecting the actively supported demand for corundum, imports of corundum ore in 1944 increased 13 percent in tonnage and 31 percent in value compared with 1943, and were the highest at least since 1924. (Before that year, corundum and emery ore were combined in one import classification, and data were not available separately.) No imports of emery ore were reported for 1944. Other classifications of emery and corundum and of diamonds generally decreased compared with 1943. "Flint, flints, and

²⁸ MacMullin, R. B., and Gardiner, W. C., *Electro-chemical and Allied Industries of the Niagara Frontier*: Trans. Electrochem. Soc., vol. 86, 1944, 18 pp. (preprint); Chem. Abs., vol. 39, No. 1, Jan. 10, 1945, p. 45.

²⁹ Ceramic Abstracts and Bulletin (Bulletin Section), William A. Harty, President and General Manager, The Exolon Co.: Vol. 24, No. 3, Mar. 15, 1945, pp. 87-90.

³⁰ Chemical Age (London), *Silicon Carbide*: Vol. 51, No. 1317, 1944, p. 302; Ceram. Abs. and Bull. (Abs. Sec.), vol. 24, No. 1, Jan. 15, 1945, p. 2.

³¹ Tikhonov, A. V., *Use of Boron Carbide as an Abrasive*: Novosti Tekhniki, 1940, No. 11-12, pp. 9-11; Chem. Abs., vol. 35, 1941, p. 865; Ceram. Abs., vol. 23, No. 5, May 15, 1944, p. 83.

³² Moore, H. F., *Shot Peening and Fatigue of Metals*: Iron Age, vol. 154, No. 18, Nov. 2, 1944, pp. 67-71, 136, 138, 140, 142.

³³ Mining Journal (London), *New Use of Monazite Products—Cerium Oxide as an Abrasive*: Vol. 222, No. 5677, June 10 1944, p. 338.

³⁴ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

flint stones, unground," which includes grinding pebbles, increased 35 percent in tonnage but still was much less than in prewar years. No prepared or "manufactured" pumice was imported in 1944. Receipts of garnet, tripoli, and crude pumice were very small.

The average value (foreign market value) of corundum in 1944 again rose in response to the industrial needs for snagging wheels and the polishing of optical equipment and reached \$68.31 per short ton, compared with \$58.60 per ton in 1943. Of interest, too, is the gradually declining value per carat of imports of industrial diamonds, which in 1944 decreased to \$1.79, thus continuing the trend in recent years toward the use of smaller diamonds, particularly in impregnated or bonded cutting and grinding tools.

The total value of exports of natural abrasive materials in 1944 declined to \$2,091,066, a decrease of 41 percent compared with 1943. The value of each class of abrasive exports was less than in 1943, emery and corundum wheels showing the largest percentage of decrease.

Abrasive materials imported for consumption in the United States, 1942-44, by kinds

Kind	1942		1943		1944	
	Quantity	Value	Quantity	Value	Quantity	Value
Burrstones: Bound up into millstones.....short tons.....	2	\$153	16	\$1,204	13	\$854
Grindstones, finished or unfinished.....short tons.....	491	18,520	295	11,130	358	14,130
Hones, oilstones, and whetstones.....short tons.....	48	59,196	4	20,039	14	18,682
Emery:						
Grains, ground, pulverized, or refined.....pounds.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Paper and cloth coated with emery or corundum.....	(²)	156,846	(²)	76,193	(²)	77,632
Wheels, files, and other manufactures of emery or corundum or garnet.....pounds.....	5,757	1,329	178,198	110,618	50,559	16,642
Corundum (see also "Emery"):						
Ore.....short tons.....	4,739	260,783	5,686	333,209	6,402	437,306
Grains, ground, pulverized, or refined.....pounds.....	¹ 124,362	¹ 7,001	¹ 245,060	¹ 12,927	¹ 72,347	¹ 5,017
Garnet in grains, ground, etc.....do.....					400	6
Tripoli and rottenstone.....short tons.....	231	4,826	6	268	3	60
Pumice: Crude or unmanufactured.....short tons.....	67	1,391	33	1,155	40	1,398
Diamond:						
Bort, manufactured.....carats.....	2,249	27,458	1,512	26,376	12	1,268
Bort (glaziers' and engravers' diamonds, unset, and miners').....carats.....	11,165,547	21,785,300	12,073,241	21,738,925	12,603,647	22,580,807
Carbonado and ballas.....do.....	38,157	272,277	10,892	151,643	10,880	236,020
Dust.....do.....	1,050	776	89,785	74,309	42,316	58,811
Flint, flints, and flint stones, unground.....short tons.....	376	5,683	484	7,165	651	7,590
		22,601,539		22,565,161		23,456,221

¹ Emery included with corundum; not separately classified.

² 1,787 reams in 1942; 1,788 reams in 1943; 890 reams in 1944; weight not recorded.

Value of domestic abrasive materials exported from the United States, 1940-44

Material	1940	1941	1942	1943	1944
Grindstones.....	\$215,156	\$187,621	\$224,998	\$213,170	\$155,048
Abrasive wheels, emery and corundum.....	179,514	144,393	3,665,386	1,334,654	942,215
All other natural abrasives, whetstones, hones, etc.....	1,211,291	2,887,628	2,793,968	2,002,704	1,693,803
	1,605,961	3,219,642	6,684,352	3,550,528	2,091,066

SULFUR AND PYRITES

By G. W. JOSEPHSON AND N. C. JENSEN ¹

SUMMARY OUTLINE

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GENERAL SUMMARY

The record of the sulfur industry during the past 3 years shows the violent changes in production that are characteristic in wartime.

Sicily took the full brunt of the war in 1943, and sulfur output stopped. Since then, as markets and operating supplies have become available, its sulfur industry has slowly and painfully been coming back to life.

Naval blockades and shortages of ships have plagued the big pyrites exporters, such as Spain, Portugal, and Cyprus. In general they have reduced their output to the level of available transportation and in some places have stock-piled products to support the local mining population.

We can only guess at the fluctuations in demand stimulated in Germany by the rain of bombs in 1944. Germany is believed to have had ample supplies of sulfur available from its own resources and those of the occupied countries supplemented by minor purchases in Spain, but destruction of industrial plants undoubtedly reduced consumption. Japanese sulfur and pyrites producers also began to feel the effects of this kind of warfare in 1944.

Many countries that were prewar importers of sulfur and pyrites from distant sources turned in self defense to sulfur-bearing minerals within their own borders or in adjacent countries. No doubt some of these developments will survive the peace, but others will contract or disappear. For example, sales of Chilean native sulfur declined in 1944. On the other hand, Australian utilization of domestic sulfide ores seems likely to continue after the war.

Although official statistics are lacking for most countries, there is evidence that world production of native sulfur increased in 1944, whereas pyrite decreased substantially.

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

In the United States, production of native sulfur, after a sharp decrease in 1943, increased in 1944 to nearly equal the record set in 1942. During the war, consumption has reached a new record annually. By the end of 1942 output had so far exceeded consumption that stocks became unwieldy, and production was reduced to a point slightly below sales. Consequently, in the past 2 years total industry stock has declined 20 percent and at the end of 1944 was at a prewar level.

Although in 1944 the War Production Board was faced with some serious shortages of sulfuric acid, sulfur itself developed no supply problems beyond a few transportation delays. No allocation orders have been applied to sulfur, nor has the Office of Price Administration found it necessary to do more than continue the application of the General Maximum Price Regulation.

POSTWAR OUTLOOK

From the physical standpoint, the domestic sulfur industry has no reconversion problem. Sulfur and pyrites will continue to serve in peace in the same forms as in war. Nor has there been any appreciable expansion in the number of producers in the United States—greater demands have been met by established companies. Compared with the practice in other industries, producer-owned stocks of sulfur seem to be large, but owing to conditions peculiar to the industry they are not abnormal and are not expected to depress the market. Increased competition from Spanish pyrite will be felt on the eastern seaboard, but native sulfur and domestic pyrite appear to be able to hold most of their present consumers.

The principal uncertainties lie in the realm of national and international trade—national prosperity will automatically bring high volume to the sulfur industry. The export market will depend on future trade agreements, monetary-exchange systems, and the degree of national self-sufficiency practiced in the importing nations. Owing to the high quality of American sulfur, its reasonable price, and the wide dispersion of its foreign sales, serious reduction in the export market is very unlikely.

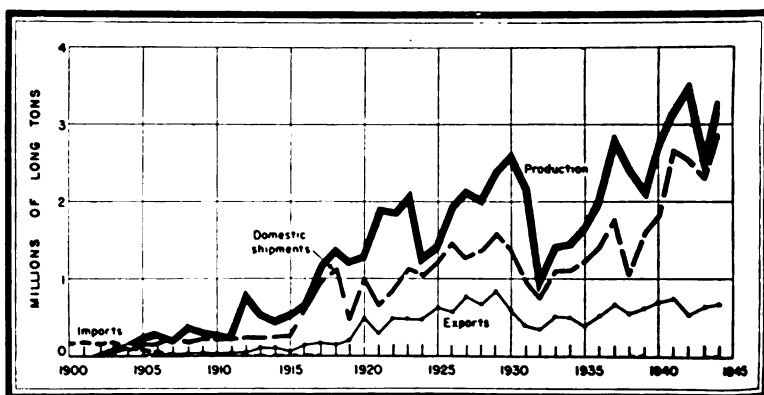


FIGURE 1.—Domestic production, shipments for domestic consumption, exports, and imports of crude sulfur, 1900-44.

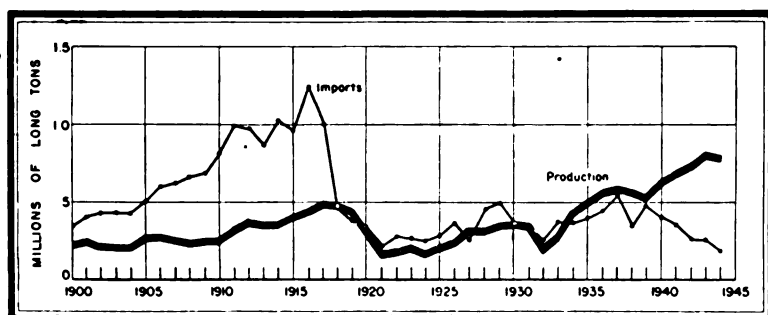


FIGURE 2.—Domestic production and imports of pyrites, 1900–44.

Salient statistics of the sulfur industry in the United States, 1935–39 (average) and 1941–44

	1935–39 (average)	1941	1942	1943	1944
Sulfur:					
Production of crude sulfur, long tons..	2, 175, 057	3, 139, 253	3, 460, 686	2, 538, 786	3, 218, 158
Shipments of crude sulfur:					
For domestic consumption...do....	1, 420, 236	2, 671, 946	2, 560, 310	2, 299, 452	2, 865, 397
For export.....do.....	566, 361	729, 464	568, 249	654, 393	653, 686
Total shipments.....do.....	1, 986, 597	3, 401, 410	3, 128, 559	2, 953, 845	3, 519, 083
Imports:					
Ore.....do.....	555	—	—	—	—
Other.....do.....	3, 427	28, 631	25, 632	16, 658	32
Exports of treated sulfur.....do.....	16, 374	31, 312	17, 030	25, 079	21, 546
Producers' stocks at end of year, do.....	3, 560, 000	3, 900, 000	4, 300, 000	3, 800, 000	3, 500, 000
Price of crude sulfur f. o. b. mines per long ton.....	\$17. 40	\$16	\$16	\$16	\$16
Pyrites:					
Production.....long tons..	544, 144	645, 257	720, 363	802, 384	788, 530
Imports.....do.....	433, 485	368, 838	300, 140	256, 308	180, 763
Price of imported pyrites c. i. f. Atlantic ports.....cents per long-ton unit..	12–13	12	12	14	14
Sulfuric acid: Production of byproduct sulfuric acid (60° B.) at copper and zinc plants.....short tons..	727, 172	915, 989	960, 764	1, 195, 707	1, 124, 582

¹ Nominal.

SULFUR

DOMESTIC PRODUCTION

Responding to the needs of peak war production, the output of crude native sulfur in 1944 was 27 percent greater than in 1943 and nearly reached the record tonnage attained in 1942. In response to continued expansion in demand, shipments from the mines were the largest on record—19 percent greater than in 1943. In addition to the sulfur from Frasch-process mines, relatively small quantities were mined in Texas and Colorado for agricultural purposes.

REVIEW BY STATES

Mines in Texas produced 80 percent and Louisiana 20 percent of the native-sulfur output of the United States in 1944.

Sulfur produced and shipped in the United States, 1940-44

Year	Produced (long tons)				Shipped	
	Texas	Louisiana	Other States ¹	Total	Long tons	Approximate value
1940.....	2,212,839	512,935	6,314	2,732,088	2,558,742	\$40,900,000
1941.....	2,596,731	537,620	8,902	3,139,253	3,401,410	54,400,000
1942.....	2,885,621	570,345	4,720	3,460,686	3,128,559	50,100,000
1943.....	1,908,581	630,205	—	2,538,786	2,953,845	47,300,000
1944.....	2,582,238	635,920	—	3,218,158	3,519,083	56,300,000

¹ 1940 and 1942: California and Utah; 1941: California.*Colorado.*—Thomas Sulphur Co. mined sulfur in Delta County.*Louisiana.*—Sulfur operations in Louisiana were limited to the Grande Ecaille mine of the Freeport Sulphur Co. in Plaquemines Parish. Output increased to 635,920 long tons in 1944.

Texas.—In Texas, the following companies produced crude sulfur in 1944: Duval Texas Sulphur Co. at Orchard Dome, Fort Bend County; Freeport Sulphur Co. at Hoskins Mound, Brazoria County; Jefferson Lake Sulphur Co., Inc., at Clemens Dome, Brazoria County; and the Texas Gulf Sulphur Co. at Boling Dome, Wharton County. The Pecos Orla Sulphur Co. mined sulfur ore at the Michigan Claims in Culberson County. At the end of the year Jefferson Lake Sulphur Co. was rapidly completing building construction at its new mine on Long Point Dome, Fort Bend County; full production is being maintained at Clemens Dome, but depletion of this deposit is anticipated in the relatively near future. The following table was compiled from information issued by the Texas State Comptroller's Office.

Sulfur produced in Texas in 1944, by companies, in long tons

Company	First quarter	Second quarter	Third quarter	Fourth quarter	Total
Texas Gulf Sulphur Co.....	324,449	491,237	544,483	481,939	1,842,108
Freeport Sulphur Co.....	100,920	89,805	87,115	89,695	367,535
Jefferson Lake Sulphur Co., Inc.....	38,126	54,277	46,520	45,542	184,465
Duval Texas Sulphur Co.....	44,140	43,510	51,785	48,695	188,130
Total.....	507,635	678,829	729,903	665,871	2,582,238

RECOVERY AS BYPRODUCT

Sulfur is a constituent of many ores that are not mined primarily for their sulfur content. Their beneficiation yields substantial quantities of byproduct pyrite, and this tonnage is included in the pyrites section of this chapter. High-temperature processing of metal sulfides liberates oxides of sulfur that are recovered as sulfuric acid at many plants as a means of eliminating a nuisance as well as for the byproduct value. In 1944, the equivalent of 284,000 tons of sulfur was recovered from the gases of copper and zinc smelters. The following table shows the output of acid at such plants during the past 5 years.

Byproduct sulfuric acid¹ (expressed as 60° B.) produced at copper and zinc plants in the United States, 1940-44, in short tons

	1940	1941	1942	1943	1944
Copper plants ¹	254,025	243,812	265,522	348,832	320,572
Zinc plants.....	586,912	672,177	695,242	846,875	804,010
Total.....	840,937	915,989	960,764	1,195,707	1,124,582

¹ Includes sulfuric acid produced as byproduct at a lead smelter.

Elemental sulfur and its compounds also may be obtained from coke-oven, refinery-still, natural, and other gases. Byproduct elemental sulfur is recovered by the Thylox, Ferrox, and Nickel processes. Plants are situated in Arkansas, Illinois, Maryland, Massachusetts, Michigan, Missouri, New Jersey, New York, Washington, West Virginia, and Wisconsin. Output in 1944 (in terms of 100 percent sulfur) totaled 19,096 long tons, of which 6,466 tons valued at \$262,266 were shipped. Approximately 60 percent was marketed in paste form containing from 35 to 52 percent sulfur, and 40 percent was dried before being sold.

Through the phenolate, phosphate, and Girbotol processes, fuel gases also yield hydrogen sulfide, much of which is subsequently converted to sulfuric acid. In 1944 the hydrogen sulfide recovered contained 21,964 long tons of sulfur. Plants are located in California, New Jersey, and Pennsylvania.

STOCKS

During 1944 producers' stocks declined 8 percent to 4,100,320 long tons, 3,539,715 of which were at the mine and 560,605 at consuming centers, ports, or in transit.

PRICES

Trade journals continued to quote crude sulfur at \$16 per long ton f. o. b. mines in 1944. Throughout the war, sulfur and acid prices have been very stable. From time to time the Office of Price Administration has considered issuing a fixed schedule of prices, but each time investigation showed that such a move was unnecessary and no action was taken.

CONSUMPTION AND USES

In 1944, as in each of the previous 4 years, consumption of sulfur in the United States attained a new record, 15 percent higher than in 1943. A calculation based upon production and change in stock indicates that total sales were approximately 12 percent greater than in 1943.

Apparent consumption of sulfur in the United States, 1940-44, in long tons

	1940	1941	1942	1943	1944
Shipments ¹	2,558,742	3,076,038	3,032,043	3,191,051	3,580,058
Imports.....	27,845	28,631	25,632	16,658	32
Total	2,586,587	3,104,669	3,057,675	3,207,709	3,580,090
Exports:					
Crude.....	746,468	729,464	568,249	654,393	653,686
Refined.....	19,745	31,312	17,030	25,079	21,546
Total	766,213	760,776	585,279	679,472	675,232
Apparent consumption	1,820,374	2,343,893	2,472,396	2,528,237	2,904,858

¹ 1940: Mine shipments; 1941-44: Apparent shipments to consumers.

² Revised figure.

Consumption of sulfur in specified industries, as estimated by Chemical and Metallurgical Engineering, is presented in the following table.

Sulfur consumed in the United States, 1940-44, by uses, in long tons

Use	1940	1941	1942	1943	1944
Chemicals.....	800,000	11,060,000	11,260,000	11,320,000	11,535,000
Fertilizer and insecticides.....	410,000	450,000	475,000	500,000	580,000
Pulp and paper.....	320,000	360,000	365,000	305,000	300,000
Explosives.....	74,000	183,000	190,000	190,000	188,000
Dyes and coal-tar products.....	51,000	65,000	60,000	65,000	75,000
Rubber.....	47,000	55,000	35,000	45,000	55,000
Paint and varnish.....	54,000	65,000	70,000	80,000	90,000
Food products.....	6,000	6,000	6,000	7,000	7,000
Miscellaneous.....	86,000	95,000	110,000	120,000	140,000
Total.....	1,848,000	2,239,000	2,471,000	2,532,000	2,870,000

¹ To avoid disclosing estimated consumption of sulfur in direct defense applications, such as military explosives, sulfur so used in 1941-44 is included under "Chemicals."

Sulfur has many uses in elemental form, but about three-fourths is converted to sulfuric acid. In addition to being a very effective reagent in the vast majority of industrial processes that require acid, sulfuric is also the cheapest in most areas. Its wide popularity is indicated in the accompanying table showing the estimates of consumption by industries made by Chemical and Metallurgical Engineering. In comparing these figures with those published in the similar tables in previous years it should be noted that whereas the tonnages were formerly expressed on a 50°B. basis, they are now converted to 100 percent sulfuric acid.

Sulfuric acid (basis 100 percent) consumed in the United States, 1942-44, by industries, in short tons

Industry	1942	1943	1944
Fertilizer.....	1,835,000	2,500,000	2,620,000
Petroleum refining.....	900,000	940,000	1,020,000
Chemicals and defense ¹	2,145,000	2,285,000	2,425,000
Coal products.....	605,000	580,000	620,000
Iron and steel.....	510,000	535,000	560,000
Other metallurgical.....	350,000	360,000	340,000
Paints and pigments.....	475,000	495,000	530,000
Industrial explosives.....	120,000	115,000	110,000
Rayon and cellulose film.....	390,000	415,000	450,000
Textiles.....	90,000	85,000	75,000
Miscellaneous.....	350,000	350,000	340,000
Total.....	7,770,000	8,660,000	9,090,000

¹ To avoid disclosing estimated consumption of acid in direct defense applications, such as military explosives, acid so used is combined with "Chemicals."

The over-all increase in consumption in 1944 (5 percent) was fairly evenly distributed over the industries, and only a few registered minor losses. The acid-production capacity of the country has been expanded substantially during the war, but even so the supply was not adequate in 1944; consequently, construction of facilities capable of contributing an additional 550,000 tons of acid annually was authorized by the War Production Board. All the plants built in the United States during the war have been designed to use native sulfur, owing to its greater availability. Some old chamber plants that utilized pyrites have been abandoned. Although consumption in nearly all uses has increased since 1940, one-third of the additional volume has gone into fertilizers and half of it into chemicals, including military explosives. On December 1, 1944, sulfuric acid was placed under Schedule 74 of General Allocation Order M-300 of the War Production Board.

FOREIGN TRADE

The United States supplies a large percentage of the foreign demand for native sulfur. In 1944 exports of sulfur to foreign countries equaled about 21 percent of the total tonnage produced in the United States. The following table shows the distribution, by countries, of these exports. In previous years a substantial tonnage of elemental sulfur was imported into the United States from British Columbia, but in 1944 only a negligible quantity entered.

Our foreign trade in sulfuric acid was nearly balanced as 20,725 short tons were exported and 17,958 tons imported.

Sulfur exported from the United States, 1943-44, by countries

Country	Crude				Crushed, ground, refined, sublimed, and flowers of			
	1943		1944		1943		1944	
	Long tons	Value	Long tons	Value	Pounds	Value	Pounds	Value
North America:								
Canada.....	208,762	\$4,717,768	208,028	\$4,616,749	7,676,983	\$216,156	6,806,111	\$198,370
Central America.....	96	3,756	138	5,488	881,896	27,364	519,145	20,510
Mexico.....	2,488	55,494	2,585	59,761	2,876,962	62,779	3,120,834	71,094
Newfoundland and Labrador.....	2,425	40,013	9,201	158,237	4,000	191	3,000	160
West Indies.....	15,201	262,859	26,105	450,255	499,741	18,850	710,277	21,240
Other North America.....					1,480	73	1,375	83
Total.....	228,972	5,079,890	246,057	5,290,490	11,941,062	325,413	11,160,742	311,457
South America:								
Argentina.....	24,160	473,775	15,550	279,900	2,001,018	29,387	22,200	7,416
Brazil.....	26,141	579,519	24,284	467,818	9,092,138	253,366	8,212,066	217,344
Chile.....					11,771	603	7,643	513
Colombia.....	497	12,016	348	7,725	689,821	20,838	168,729	5,475
Ecuador.....	4	272	1	97	25,794	788	87,960	2,679
Peru.....			50	1,156	285,227	7,654	596,547	16,005
Uruguay.....	4,232	98,118	4,200	75,600	2,773,800	67,753	764,323	13,736
Venezuela.....				125,574	3,464	309,941	9,684	
Other South America.....	175	4,872	76	2,908	22,924	1,004	140,338	4,079
Total.....	55,209	1,168,572	44,509	835,204	15,028,067	384,857	10,309,747	276,931
Europe:								
Ireland.....					427,795	9,426	156,800	3,515
Malta, Gozo, and Cyprus Islands.....					269,570	6,455	751,440	18,459
United Kingdom ¹	254,894	4,064,231	200,664	3,145,823	50,250	16,178	73,050	24,656
Other Europe.....			2,500	45,000			34,754	1,457
Total.....	254,894	4,064,231	203,164	3,190,823	747,615	32,059	1,018,044	48,087
Asia:								
Ceylon.....	11	625	39	2,058	1,311,330	32,804	2,801,131	76,109
China.....					7,500	3,038		
India and Dependencies.....	24,649	546,998	25,990	541,986	11,634,688	218,261	7,572,635	120,519
Iran.....	11,159	227,137	11,218	244,808	455,400	4,948		
Palestine and Trans-Jordan.....	3,250	65,713	2,392	54,931	449,010	10,188	2,319,385	50,755
State of Bahrain.....	2,616	65,015	664	21,388	30,015	2,421	1,490,935	21,661
Syria.....	102	5,918					403,200	9,088
Turkey.....	1,500	30,375					2,299,537	37,524
Other Asia.....							100,000	2,263
Total.....	43,287	942,701	40,303	865,171	13,887,943	271,660	16,986,823	317,919
Africa:								
Algeria.....					11,318,605	260,481	2,202,873	42,252
Belgian Congo.....					329,635	10,927	10,756	581
British East Africa.....	297	14,759	211	11,956	2,239,596	57,177	1,240,052	30,842
Egypt.....	150	4,758	605	22,017	12,782	751	3,056,795	75,229
French West Africa.....							12,300	373
Madagascar.....					44,000	1,210	478,680	13,747
Mozambique.....	100	2,250	200	4,940				
Nigeria.....					101,081	3,651	55,300	1,907

¹ United Kingdom of Great Britain and Northern Ireland.

Sulfur exported from the United States, 1943-44, by countries—Continued

Country	Crude				Crushed, ground, refined, sublimed, and flowers of			
	1943		1944		1943		1944	
	Long tons	Value	Long tons	Value	Pounds	Value	Pounds	Value
Africa—Continued.								
Union of South Africa.....	20,850	\$352,816	31,080	\$536,155	338,860	\$28,333	1,519,550	\$78,564
Other Africa.....	5	198	-----	-----	10,928	566	4,768	394
Total.....	21,402	374,781	32,186	575,068	14,395,487	363,096	8,581,074	243,889
Oceania:								
Australia.....	25,160	425,518	36,477	618,085	138,815	4,761	151,472	5,493
New Zealand.....	25,469	419,309	50,990	861,446	34,964	2,030	47,604	1,367
Other Oceania.....	-----	-----	-----	-----	2,060	140	7,285	221
Total.....	50,629	844,827	87,467	1,479,531	175,839	6,931	206,361	7,071
Grand total.....	654,393	12,475,002	653,686	12,236,287	56,176,013	1,384,016	48,262,791	1,205,354

Sulfur imported into and exported from the United States, 1940-44

Year	Imports				Exports			
	Ore		In any form, n. e. s.		Crude		Crushed, ground, refined, sublimed, and flowers of	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
1940.....	(1)	\$5	27,845	\$473,052	746,468	\$13,041,911	19,745	\$780,968
1941.....	-----	-----	28,631	487,758	729,464	12,520,068	31,312	1,360,683
1942.....	-----	-----	25,632	442,811	558,249	10,942,703	17,030	911,598
1943.....	-----	-----	16,658	343,083	654,393	12,475,002	25,079	1,384,016
1944.....	-----	-----	32	9,942	653,686	12,236,287	21,546	1,205,354

¹ Less than 1 ton.**WORLD PRODUCTION**

High production of sulfur in the United States overcame the decline in Italy and elsewhere in 1944. Official statistics are lacking, but it is believed that world production of elemental sulfur, including that derived from gases, totaled about 3,800,000 long tons in 1944.

World production of native sulfur, 1937-44, by countries, in long tons¹

[Compiled by B. B. Waldbauer]

Country ¹	1937	1938	1939	1940	1941	1942	1943	1944
Argentina.....	-----	-----	-----	-----	367	2,148	11,810	(7)
Bolivia (exports).....	1,712	1,632	2,126	4,065	2,315	3,535	7,079	6,151
Chile ²	16,766	20,959	26,999	32,440	28,745	33,825	36,310	(7)
Ecuador.....	54	68	72	(7)	(7)	-----	61	13
France (content of ore).....	157	140	(7)	(7)	(7)	(7)	(7)	(7)
Greece.....	67	75	(7)	(7)	(7)	(7)	(7)	(7)
Guatemala.....	11	15	12	11	(7)	410	410	(7)
Italy (crude) ³	338,101	374,339	224,091	204,997	192,178	145,604	91,773	9,292
Japan.....	138,283	(7)	(7)	(7)	(7)	(7)	(7)	(7)
Mexico.....	(7)	49	(7)	(7)	(7)	26,115	27,901	(7)
Netherlands East Indies.....	12,474	15,986	17,293	(7)	(7)	(7)	(7)	(7)
Palestine.....	494	1,196	829	1,358	3,365	(7)	(7)	(7)
Peru.....	1,531	1,944	559	610	935	875	564	(7)
Spain ⁴	940	900	3,770	3,560	6,230	5,000	5,511	5,700
Turkey.....	2,229	3,684	2,540	2,600	2,600	2,600	2,600	(7)
United States.....	2,741,970	2,393,408	2,090,979	2,732,088	3,139,253	3,460,686	2,538,786	3,218,158
Estimated world total.....	3,300,000	3,000,000	2,700,000	3,300,000	3,700,000	4,000,000	3,000,000	3,500,000

¹ Native sulfur believed to be produced also in China, Cuba, India, Iran, Taiwan, and U. S. S. R., but quantity unknown.² Data not available.³ In addition, 1,050 tons of sulfur rock (40-80 percent sulfur) reported for 1937.⁴ Estimate.⁵ In addition, following quantities of sulfur rock reported—1937: 19,793 tons; 1938: 16,545. Similar data not available for later years.⁶ Production of Sicily for fiscal year ended July 31 of year stated.⁷ The incomplete datum cited is crude sulfur ore; total production and sulfur content are unknown.⁸ Exports.⁹ Estimated sulfur content of ore, excluding sulfur made from pyrites.

Argentina.—In 1944 Argentina continued its efforts to develop an adequate domestic supply of sulfur. Industrias Químicas Nacionales, S. M., a corporation financed by both private and Government capital, had hoped to increase production from its mine and plant south of Socompa sufficiently to approach the national consumption—about 30,000 tons annually. However, these operations are in the Andes, where landslides, transportation difficulties, and other problems peculiar to high altitudes often interfere; consequently, production is reported to have reached only 8,000 metric tons in 1944. A shortage of sulfur developed early in the year, but this was soon relieved by imports from the United States and Chile. In the first 11 months 26,910 tons were imported.

Chile.—Development of a stable and profitable native sulfur industry in Chile is handicapped by high costs growing out of the unfavorable occurrence of the deposits when compared with those in the United States and Italy. Chilean producers enjoyed a temporary increase in demand in 1942 and 1943 when South American consumers found it difficult to obtain American sulfur, but in 1944 exports from Chile declined drastically.

Mexico.—According to official figures, exports of refined sulfur aggregated 1,002 metric tons in 1944.

In past years Mexican sulfur production has come from surface or shallow deposits mined by conventional methods, and output has been small. The possibility of developing larger operations in the future is indicated by explorations in the State of Veracruz. Engineers say that sulfur domes are known in this area, and plans for their exploitation by the Frasch process are under consideration. The organization of two companies that would develop these domes with Government assistance has been reported, and one has begun drilling its first prospect hole.

Sicily.—In the fiscal year 1943–44, the Sicilian sulfur industry sank to nearly complete collapse. Only 31 mines were in spasmodic operation, and production totaled 9,441 metric tons.

In the more normal year 1935–36, output totaled 224,397 metric tons. In that year 106 mines were in operation, 7 of which produced over 10,000 tons each, 13 had capacities of 5,000 to 10,000 tons, 25 could produce 1,000 to 5,000 tons, and 61 less than 1,000 tons.

During the fighting, many of the mines were flooded and much equipment must be replaced before operations can be resumed. At present, power and supplies are scarce and expensive, but some progress has been made in re-equipping the mines, and output for the last 5 months of 1944 increased to 22,556 tons.

When the Allies assumed control of Sicily in 1943, about 25,000 tons of sulfur were found in stock. By the end of 1944, the Allied Commission had exported 19,000 tons to North Africa and 13,000 tons to Great Britain, and stocks were about 24,000 tons. The current price fixed by the Allied Commission is \$45 per ton alongside ship at seaport. Formerly, sulfur sales were handled through the Ufficio Per Le Vendite Dello Zolfo Italiano, a Government organization with headquarters in Rome. A purely Sicilian sales organization, the Ente Zolfi Siciliani, has now been formed to handle the products of Sicilian sulfur mines. Delivery is made to the Consorzio Magazzini Generali, a cooperative warehousing concern, which pays producers 83 percent of the price on delivery and holds the sulfur for disposition

by the sales company. Ente Zolfi Siciliani, a nonprofit organization, divides the proceeds of its sales proportionately among the producers after reimbursing Magazzini Generali for payments already made.

PYRITES

DOMESTIC PRODUCTION

After setting new records in each of the previous 4 years, production of pyrites in the United States declined 2 percent in 1944. Of the total tonnage, 89 percent was classified as fines and the remainder as lump.

Pyrites (ores and concentrates) produced in the United States, 1940-44

Year	Quantity		Value	Year	Quantity		Value
	Gross weight (long tons)	Sulfur content (percent)			Gross weight (long tons)	Sulfur content (percent)	
1940.....	626, 640	41. 8	\$1, 920, 000	1943.....	802, 384	40. 9	\$2, 844, 000
1941.....	645, 257	41. 9	2, 009, 000	1944.....	788, 530	42. 2	2, 598, 000
1942.....	720, 363	42. 6	2, 464, 000				

For many years prices have not been sufficiently attractive to strongly encourage the production of pyrite for sale on the open market. Consequently, domestic production is largely by companies that can utilize the material locally, principally for conversion to acid. In 1944, the producing companies consumed 575,788 long tons, whereas they sold only 212,099 tons.

REVIEW BY STATES

California.—Output from the Hornet mine of the Mountain Copper Co., in Shasta County, made California the second-largest pyrites-producing State in 1944.

Colorado.—The Rico Argentine Mining Co. operated its mine in Dolores County, Colo., in 1944.

Illinois.—At its Atkinson mine in Henry County, the Midland Electric Coal Corp. recovered 8,259 long tons of pyrites (coal brasses). As these occur in the coal as seams or lenses up to 4 inches in thickness, only moderate crushing is required to free them, allowing separation from washer waste, by jigs, of additional salable coal as well as byproduct lump pyrite.

Indiana.—Output of pyrite (coal brasses) by the Snow Hill Coal Corp. at the Talleydale mine in Vigo County increased in 1944.

Montana.—The Anaconda Copper Mining Co. recovered a substantial tonnage of pyrite in 1944 as a byproduct of its copper-plant operations at Anaconda in Deer Lodge County.

New York.—The St. Joseph Lead Co. shipped pyrites from the Balmat mine in St. Lawrence County in 1944.

Pennsylvania.—The Bethlehem Steel Co. produced pyrites in Lebanon County.

Tennessee.—As in past years, Tennessee led all other States in the production of pyrites. Output came from mines in Polk County operated by the Tennessee Copper Co. and was converted by that company to sulfuric acid and iron sinter.

Virginia.—Pyrites were produced by the General Chemical Co. at the Gossan mine to supply its sulfuric acid plant at Pulaski.

Wisconsin.—The Vinegar Hill Zinc Co. recovered pyrites in Grant County and converted them into acid.

FOREIGN TRADE

Prior to the war, pyrite imports commonly ranged between 300,000 and 500,000 long tons annually, most of which came from Spain. As war conditions limited the shipping available to this trade, receipts from Spain declined rapidly. Canada was able to offset the loss for a time, but this tonnage dwindled when the ore body of one of the mines was exhausted in 1943. As ample native sulfur was available in the United States to replace the lost pyrite, there was little incentive to bolster pyrite imports through Government action. All available allied shipping was needed for other services, so imports of Spanish pyrites were carried only in neutral ships in 1944. Importers were in a poor position to compete for even these few bottoms, as prices of pyrite in the United States were too low to assure a profit after payment of wartime ocean freight charges. Consequently, only a few thousand tons of Spanish pyrites entered the United States in 1944, and total imports were 29 percent lower than in 1943.

Pyrites containing more than 25 percent sulfur imported for consumption in the United States, 1940-44, by countries

Country	1940		1941		1942		1943		1944	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Canada.....	81, 157	\$560, 476	244, 287	\$1, 151, 964	282, 897	\$1, 313, 295	197, 750	\$683, 110	166, 575	\$302, 747
Mexico.....	203	719	320	1, 500	682	2, 995	273	916	.....	.....
Spain.....	325, 644	790, 172	124, 231	326, 052	16, 561	43, 866	58, 285	147, 533	14, 188	36, 896
Total..	407, 004	1, 351, 367	368, 838	1, 479, 516	300, 140	1, 360, 156	256, 308	831, 559	180, 763	339, 643

In peacetime the bulk of the pyrite imported enters various customs districts on the eastern seaboard (principally Philadelphia and Maryland), and, after being burned, much of the cinder is shipped to Wilmington, Del., for recovery of residual metallic products. In 1944 entry was mainly through the Buffalo district. Metal-recovery activities continued on a reduced scale.

Pyrites containing more than 25 percent sulfur imported for consumption in the United States, 1940-44, by customs districts, in long tons

Customs district	1940	1941	1942	1943	1944
Buffalo.....	80, 076	227, 510	225, 924	159, 483	134, 955
Maryland.....	19, 702	24, 231	12, 561	10, 357	.....
Massachusetts.....	.....	.....	82	69	.....
Michigan.....	.....	12, 569	29, 163	28, 051	29, 785
Montana and Idaho.....	.....	.....	366	.....	.....
New York.....	82, 292	317	.....	.....	.....
Ohio.....	.....	.....	1	71	1
Philadelphia.....	215, 373	88, 219	6, 102	47, 928	14, 188
St. Lawrence.....	.....	.....	80	.....	.....
San Diego.....	203	320	732	273	.....
Vermont.....	937	3, 889	15, 440	8, 562	.....
Virginia.....	8, 331	11, 781	4, 000	.....	.....
Washington.....	90	2	5, 689	1, 514	1, 834
Total.....	407, 004	368, 838	300, 140	256, 308	180, 763

WORLD PRODUCTION

Owing to the strategic importance of pyrites in the war industries of many countries, production statistics have been released by comparatively few. Because many of the large pyrite-producing and consuming areas were under direct military attack, it is estimated that world production may not have exceeded 7,000,000 metric tons in 1944.

*World production of pyrites (including cupreous pyrites), 1938, 1942, 1943, and 1944, by countries, in metric tons*¹

[Compiled by B. B. Waldbauer]

Country ¹	1938		1942		1943		1944	
	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content
Algeria.....	44,150	19,430	35,820	15,716	27,337	(?)	(?)	(?)
Australia:								
Tasmania.....	51,084	(?)	35,002	(?)	33,736	(?)	29,787	(?)
Western Australia.....			374	(?)	10,353	(?)	(?)	(?)
Canada.....	40,464	20,300	344,268	165,813	258,162	126,505	(?)	(?)
Cyprus (exports).....	523,574	250,551	5,051	(?)	13,198	(?)	(?)	(?)
Czechoslovakia ²	(?)	(?)	10,000	(?)	(?)	(?)	(?)	(?)
Finland.....	102,979	44,281	(?)	(?)	(?)	(?)	(?)	(?)
France.....	147,208	65,655	(?)	(?)	(?)	(?)	(?)	(?)
Germany.....	465,267	200,064	(?)	(?)	(?)	(?)	(?)	(?)
Greece.....	244,000	118,605	(?)	(?)	(?)	(?)	(?)	(?)
Italy.....	930,312	386,079	(?)	(?)	(?)	(?)	(?)	(?)
Norway.....	1,027,776	446,939	824,400	(?)	800,348	(?)	(?)	(?)
Poland.....	92,209	36,883	(?)	(?)	(?)	(?)	(?)	(?)
Portugal.....	558,327	251,250	128,280	57,720	109,994	49,500	121,249	54,560
Rumania.....	80,900	(?)	(?)	(?)	(?)	(?)	(?)	(?)
Southern Rhodesia.....	27,065	10,900	39,941	(?)	36,905	(?)	(?)	(?)
Spain ³	2,727,003	1,145,341	627,005	263,300	881,150	370,100	511,320	214,750
Sweden.....	186,390	84,345	(?)	(?)	(?)	(?)	(?)	(?)
Union of South Africa.....	31,017	13,947	40,467	17,959	37,030	16,195	18,240	8,042
United Kingdom.....	4,351	(?)	5,739	(?)	9,749	(?)	(?)	(?)
United States.....	564,547	222,612	731,925	311,885	815,262	333,442	801,186	337,700
Uruguay.....	70	(?)	(?)	(?)	(?)	(?)	(?)	(?)
Yugoslavia.....	150,402	67,681	(?)	(?)	(?)	(?)	(?)	(?)
Estimated world total	10,000,000	4,300,000	9,000,000	3,900,000	9,000,000	3,900,000	7,000,000	3,000,000

¹ In addition to countries listed Belgium, Brazil, China, Chosen, Eire, India, Japan, and U. S. S. R. produced pyrites, but production data are not available.

² Data not available. ³ Slovakia only. ⁴ Estimate. ⁵ Incomplete data.

⁶ Revised estimate; previous data proved to be production of only one mine.

⁷ Exports.

⁸ Average sulfur content of pyrites was 42 percent in 1931, latest year for which such information was available.

⁹ January to June, inclusive.

Australia.—As Australia is distant from the major sources of sulfur she encourages the use of domestic ores. A bounty (27 shillings per ton when imported brimstone costs £6) is paid to producers using Australian minerals. In 1937–38, 462,871 tons of sulfuric acid were produced in Australia, of which 73 percent was made from brimstone, 16 from zinc concentrates, 11 from pyrites, and 0.03 from spent oxide. The brimstone came principally from the United States, but substantial quantities came from Italy and Japan. Acid requirements during the war have been much lower, owing to a shortage of phosphate rock following the loss of Nauru and Ocean Islands. In 1943–44, output was 244,787 tons of acid, of which 33 percent was made from brimstone, 27 from zinc concentrates, 37 from pyrites, and 3 from spent oxide. The trend has therefore been toward greater self-sufficiency. Indications are that the trend will go still farther, as recovery from zinc concentrates was below capacity in 1943–44, and superphosphate companies in Western Australia have contracted to use

pyrite concentrates from Norseman to fill their acid requirements. The average value of sulfur imports for 7 years before the war was £438,000—a substantial and attractive market to producers who have surpluses of sulfide concentrates.²

Brazil.—Although Brazil is rich in most natural resources, it has not developed a domestic source of sulfur. Imports from the United States and Chile have been well-maintained during the war, and no serious shortages occurred. It is possible that Brazil may obtain its sulfur from coal brasses at some future time. To serve the growing iron and steel industry as well as other domestic fuel needs, the Brazilian Government is investigating the possibility of beneficiating pyritiferous coal for the dual purpose of improving its quality and obtaining a pyrite byproduct to supply the nation's sulfur requirements. In addition to extensive laboratory work carried on in Brazil, engineers studied coal-washing practice in the United States in 1944.³

Canada.—Waite Amulet Mines, Ltd., has begun to market pyrite obtained as a byproduct of its metal-mining operations. A newly installed pyrite-concentrating plant began operating early in 1944, and 48,925 tons of pyrite were shipped during the year. At the end of the year sales were averaging about 3,700 gross tons per month.⁴

Cyprus.—In 1944 the pyrites industry on Cyprus was still dormant owing to war conditions.

Norway.—Unofficial but apparently reliable production statistics indicate that war conditions have not reduced Norwegian pyrite production drastically. Output for the war years was given as follows: 1939, 1,024,953 metric tons; 1940, 762,312; 1941, 954,541; 1942, 826,415; and 1943, 800,800. In the first 5 months of 1944 production was maintained at about the same rate as in 1943.

Portugal.—Like the rest of the Iberian pyrites industry, mining in Portugal was reduced to the bare minimum required to keep the mines open and to sustain the miners and their families. Before the war, about 500,000 metric tons were produced annually, of which over 80 percent was exported to France, Belgium, Great Britain, Holland, and French Morocco. During the war, output declined steadily to about 110,000 tons in 1943 and 1944.

In Portugal, pyrites are obtained chiefly from three groups of mines in Baixo Alentjo Province. The S. Domingos group, operated under a concession by a British company, formerly produced about 300,000 tons a year, but in 1944 it was down to a little less than 100,000 tons. The Aljustrel group, operated by a Belgian concern, in normal times produced 250,000 tons annually, but output has diminished to 6,000 tons since the war. The Grandola group, smallest of the three, has produced up to 100,000 tons a year; in 1944, however, only 24,000 tons were produced. Exports must be made in light-tonnage vessels, because the S. Domingos group ships from Pamarao on the Guadiana River, and the other two groups ship from Setubal.

Spain.—Production of pyrites in Spain continued on a reduced basis in 1944; output totaled 511,320 metric tons. The American market was nearly inaccessible, but in the first 11 months Great Britain took 157,771 tons; French Morocco, 13,770; Switzerland, 9,747; Ireland 8,000; and Germany 26,444 tons (compared with

² The Mining Journal (London), vol. 224, No. 5718, March 24, 1945, p. 183.

³ Personal communication from F. E. Noe.

⁴ The Northern Miner, vol. 31, No. 2, April 5, 1945, p. 14.

43,273 in 1943). In 1943, pyrites were produced in 5 provinces, as follows: Alava, 1,312 metric tons; Huelva, 470,538; Huesca, 113; Murcia, 20,115; and Sevilla, 22,670. In 1944, most of the output came from the Huelva mines of the Rio Tinto Co., Ltd., and the Tharsis Sulphur & Copper Co., Ltd. The Compagnie Française des Pyrites de Huelva, Compañía Buitron, S. A., Union Española de Explosivos, S. A., and Arrendatarios de San Telmo S. A. also were active in Huelva. In Seville Province, producers were Sociedad Española de Minas del Castillo de la Guardas, the Seville Sulphur & Copper Co., Ltd., the Pena Copper Mines, and Sociedad Minera del Guadiana. Union Española de Explosivos also mined in Murcia Province.

Current domestic and export sales are not nearly sufficient to maintain the pyrites industry at its accustomed rate of production, and even at present reduced rates, which serve to support the mining population and maintain the mines and plants, stock piles are being accumulated. Spain hopes to recapture its export markets after the war. Prices of pyrites for export range from 16 to 24 shillings per ton. The freight rate offered on shipments to the United States from Huelva is \$7.50 per ton, a figure that does not attract many ships under present conditions.

Sweden.—Owing to her isolated position during the war, Sweden has had to enlarge her production of pyrites and sulfur. Her needs are being met by expansion of pyrites output in the Boliden area to about 400,000 tons combined with the output of the Falun mines. Possibly 20,000 tons of elemental sulfur are recovered annually from flue gases of the Ronnskar smelter and shale-oil plants.⁵

⁵ The Chemical Age, vol. 51, No. 1313, August 26, 1944, p. 205.

PHOSPHATE ROCK

By BERTRAND L. JOHNSON AND E. M. TUCKER¹

SUMMARY OUTLINE

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GENERAL CONDITIONS

Another record for the annual marketed production of domestic phosphate rock was made in 1944, the quantity sold or used by producers reaching 5,376,643 long tons (see fig. 1)—about one-quarter mil-

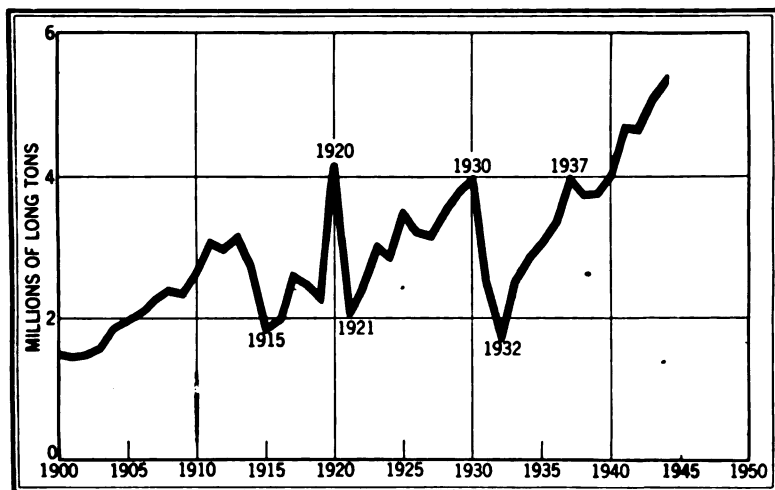


FIGURE 1.—Marketed production of domestic phosphate rock, 1900-1944.

lion tons above the figure reported for 1943, the previous record. All States except Virginia showed increases. The total value (\$20,856,429) was nearly 2 million dollars greater than in 1943. Mined production was over 5 million tons in 1944. Exports changed their trend from recent years, rising considerably in 1944. Imports increased markedly, rising from 46,505 tons in 1943 to 123,414 tons in 1944. Apparent domestic consumption exceeded 5 million tons. Figures for mined production and stocks for 1944 are not strictly comparable with those for 1943 because of the inclusion in 1943 of considerable quantities of

¹ Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Tennessee brown-rock matrix in the reported figures. The P_2O_5 content of the domestic phosphate rock sold or used in 1944 was 1,739,489 tons.

Salient statistics of the phosphate-rock industry in the United States, 1943-44

	1943				1944			
	Long tons		Value at mines		Long tons		Value at mines	
	Rock	P_2O_5 content	Total	Average	Rock	P_2O_5 content	Total	Average
Production (mined).....	5,369,967	1,611,215 ¹	(¹)	(¹)	5,200,002	1,673,860	(¹)	(¹)
Sold or used by producers:								
Florida:								
Land pebble.....	3,483,194	1,179,314	\$11,633,241	\$3.34	3,670,208	1,241,519	\$13,136,472	\$3.58
Soft rock.....	71,171	14,739	254,995	3.58	60,087	12,526	259,523	4.32
Hard rock.....	34,128	12,208	201,241	5.90	22,500	8,056	138,932	6.18
Total Florida.....	3,588,493	1,206,261	12,089,477	3.37	3,752,795	1,262,101	13,534,947	3.61
Tennessee ^{2,3}	1,309,059	375,502	5,822,249	4.45	1,324,849	381,621	5,975,337	4.51
Idaho.....	108,916	34,709	561,630	5.16	112,565	35,804	584,400	5.19
Montana.....	119,764	38,021	488,665	4.08	186,434	59,963	761,745	4.09
Virginia.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Total United States.....	5,126,232	1,654,493	18,962,021	3.70	5,376,645	1,739,489	20,856,429	3.88
Imports ⁴	46,505	(¹)	377,158	8.11	123,414	(¹)	1,005,132	8.14
Exports ⁴	358,010	(¹)	2,871,136	8.02	438,133	(¹)	3,460,916	7.90
Apparent consumption ⁵	4,814,727	(¹)	-----	-----	5,061,924	(¹)	-----	-----
Stocks in producers' hands, Dec. 31:								
Florida.....	1,110,000	371,000	(¹)	(¹)	815,000	273,000	(¹)	(¹)
Tennessee ^{2,3}	640,000	136,000	(¹)	(¹)	410,000	115,000	(¹)	(¹)
Western States.....	2,000	1,000	(¹)	(¹)	2,000	1,000	(¹)	(¹)
Total stocks.....	1,752,000	508,000	(¹)	(¹)	1,227,000	389,000	(¹)	(¹)

¹ Data not available.

² Includes sintered matrix.

³ Virginia included with Tennessee.

⁴ Market value (or price) at port and time of exportation to the United States.

⁵ Value at port of exportation.

⁶ Quantity sold or used by producers plus imports minus exports.

⁷ Includes brown-rock matrix of sinter grade, sintered brown rock, blue rock, and some matrix of washer grade.

General papers published recently include those by Gray,² Jacob,³ Brown and Jacob,⁴ Johnson,⁵ Sauchelli,⁶ Sisco,⁷ and Popular Mechanics.⁸

POSTWAR OUTLOOK

It is natural to expect that, after cessation of hostilities, prewar conditions in the phosphate-rock industry will return, with the reopening of the old markets abroad and a more normal demand for phosphate rock in the United States. However, the world has been completely upset by the greatest war in history, and the organization of the postwar world has not yet been decided upon. Colossal war expenditures by the fighting countries forecast complicated financial

² Gray, A. N., *Phosphate and Superphosphate*: 2d edit., London 1944, 416 pp.

³ Jacob, K. D., *Uses of Phosphates*: Min. and Met., vol. 25, No. 454, October 1944, pp. 488-491.

⁴ Brown, B. E., and Jacob, K. D., *Greenhouse and Field Tests Comparing Colloidal Phosphate, Phosphate Rock, and Superphosphate as Sources of Phosphorus for Various Crop Plants*: Am. Fertilizer, vol. 101, No. 13, Dec. 30, 1944, pp. 7-10, 22, 24, 26, 28, and 30. *Greenhouse Pot-Culture Tests on Rock Phosphates as Sources of Phosphorus for Plants*: Am. Fertilizer, vol. 102, No. 1, Jan. 13, 1945, pp. 11-12, 28, and 30.

⁵ Johnson, Bertrand L., *Economic Factors in the U. S. Phosphate Industry*: Min. and Met., vol. 25, No. 454, October 1944, pp. 455-465.

⁶ Sauchelli, Vincent, *Phosphates—Present Uses and Future Outlook in Crop Production in the United States*: Am. Fertilizer, vol. 101, No. 5, Sept. 9, 1944, pp. 7-10, 28, and 30.

⁷ Sisco, F. T., *Phosphorus in the Metal Industries*: Min. and Met., vol. 25, No. 454, October 1944, p. 491.

⁸ Popular Mechanics, *Industry's Dr. Jekyll and Mr. Hyde*: November 1943, pp. 41-45 and 150.

difficulties, with possibly even greater economic instability than in the interval between World Wars I and II. The principal foreign markets for domestic phosphate rock were the Axis nations, whose future is not yet settled. Intense competition in all European markets is to be expected from the high-grade Russian phosphate deposits and from the rejuvenated phosphate-producing industry of French North Africa. These sources are within easy shipping distance of European markets and may be favored by depreciated currencies. Some improvement from the war-depressed condition of our export trade in phosphate rock is to be expected, but domestic producers may obtain less of the foreign market than they held in the prewar years.

The present record domestic consumption is abnormal, as it is based upon an extraordinarily high war-stimulated farm income. Congress, however, has guaranteed the farmers 90 percent of parity for their crops for 2 years; hence farm income may continue at a high level for some time, with concomitant large fertilizer purchases. With later declines from war-increased food demands and high agricultural prices, farm income may be expected to decline, followed by declines in fertilizer consumption and in the sales of phosphate rock for fertilizer manufacture. In the industrial and chemical field the greatly expanded facilities for production of phosphorus brought about by war demands will be excessive for peacetime needs unless new products and new processes are developed.

PRODUCTION

Phosphate rock was mined in 1944 in Florida, Tennessee, Montana, and Idaho and apatite in Virginia. Increased production is reported from Florida and the Western States. The Tennessee figure and that for the total United States mined production are not strictly comparable with those for 1943, because of the inclusion of considerable quantities of washer-grade phosphatic matrix in some of the earlier reports from Tennessee. A more detailed classification called for in the schedules now used has made it possible to eliminate most of this material from the 1944 totals.

Phosphate rock mined in the United States, 1935-44, by States, in long tons

Year	Florida	Tennes- see ¹	West- ern States	United States	Year	Florida	Tennes- see ¹	West- ern States	United States
1935	2,598,337	493,501	67,490	3,159,328	1940	2,782,956	1,120,551	164,570	4,068,077
1936	2,645,819	737,866	79,152	3,462,837	1941	3,417,900	1,301,067	203,216	4,922,183
1937	3,179,588	942,158	139,670	4,261,416	1942	2,984,503	1,568,162	266,273	4,818,938
1938	2,722,927	1,999,551	137,998	3,860,476	1943	3,274,266	1,868,407	227,294	5,369,967
1939	2,791,360	1,057,570	139,040	3,987,970	1944	3,486,482	1,413,246	300,274	5,200,002

¹ Includes small quantity of apatite from Virginia.

² Includes small quantity of phosphate rock from South Carolina.

³ Includes some matrix of washer grade.

SALES

The quantity of domestic phosphate rock sold or used by producers reached a new high record in 1944 and exceeded the previous maximum of 1943 by 250,411 long tons. The total value in 1944 was nearly 2 million dollars above that of 1943. The average value per ton of the phosphate rock sold or used was nearly 5 percent greater than in 1943.

Phosphate rock sold or used by producers in the United States, 1940-44

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1940.....	4,002,700	\$12,334,662	\$3.08	1943.....	5,126,232	\$18,962,021	\$3.70
1941.....	4,689,652	15,596,273	3.33	1944.....	5,376,643	20,856,429	3.88
1942.....	4,644,240	16,597,492	3.57				

DISTRIBUTION OF SALES

The most popular grades of phosphate rock sold or used by producers in the United States in 1944, according to reports from them, were the 72-percent B. P. L. grade and the 75/74-percent B. P. L. grade. The quantity of phosphate rock containing less than 60 percent B. P. L. sold or used continued to increase and in 1944 formed 12 percent of the total.

In 1944 the quantity of domestic phosphate rock sold or used by producers in the United States for the production of superphosphate is reported to have been slightly larger than in 1943. Increases were also registered in the quantity sold or used for the production of various chemicals and also for direct application to soil. Less is reported to have been used in 1944 than in 1943 for fertilizer filler and for stock and poultry feed.

Phosphate rock sold or used by producers in the United States, 1943-44, by grades and uses

	1943			1944		
	Quantity		Value	Quantity		Value
	Long tons	Percent of total		Long tons	Percent of total	
Grades—B. P. L.¹ content (percent):						
Below 60.....	566,704	11	(²)	669,228	12	(²)
60 to 66.....	186,726	4	(²)	210,561	4	(²)
68 basis, 66 minimum.....	264,043	5	(²)	223,935	4	(²)
70 minimum.....	490,208	9	(²)	672,218	13	(²)
72 minimum.....	1,611,500	31	(²)	1,291,850	24	(²)
75 basis, 74 minimum.....	698,476	14	(²)	1,107,149	21	(²)
77 basis, 76 minimum.....	851,055	17	(²)	883,815	16	(²)
Above 85 (apatite).....	457,520	9	(²)	317,887	6	(²)
Undistributed ³						
	5,126,232	100	\$18,962,021	5,376,643	100	\$20,856,429
Uses:						
Domestic:						
Superphosphates.....	3,631,786	71	(²)	3,681,274	69	(²)
Phosphates, phosphoric acid, phosphorus, ferrophosphorus.....	846,305	17	(²)	890,633	17	(²)
Direct application to soil.....	193,931	4	(²)	256,736	5	(²)
Fertilizer filler.....	27,690	(⁴)	(²)	19,008	(⁴)	(²)
Stock and poultry feed.....	67,288	1	(²)	55,944	1	(²)
Undistributed ⁵	8,347	(⁴)	(²)	27,932	(⁴)	(²)
Exports ⁶	350,885	7	1,607,909	445,116	8	(²)
	5,126,232	100	18,962,021	5,376,643	100	20,856,429

¹ Bone phosphate of lime.² Figures not available.³ Includes numerous grades of B. P. L. content from 65.9 to 85 percent.⁴ 0.5 percent or less.⁵ Includes phosphate rock used in pig-iron blast furnaces, parting compounds, research, defluorinated phosphate fertilizers, refractories, and other uses.⁶ As reported to Bureau of Mines by domestic producers.

CONSUMPTION

The abnormal rise in the annual apparent consumption of phosphate rock in the United States under war conditions continued in 1944. (See fig. 2.) Again attention is called to the ever-increasing width of

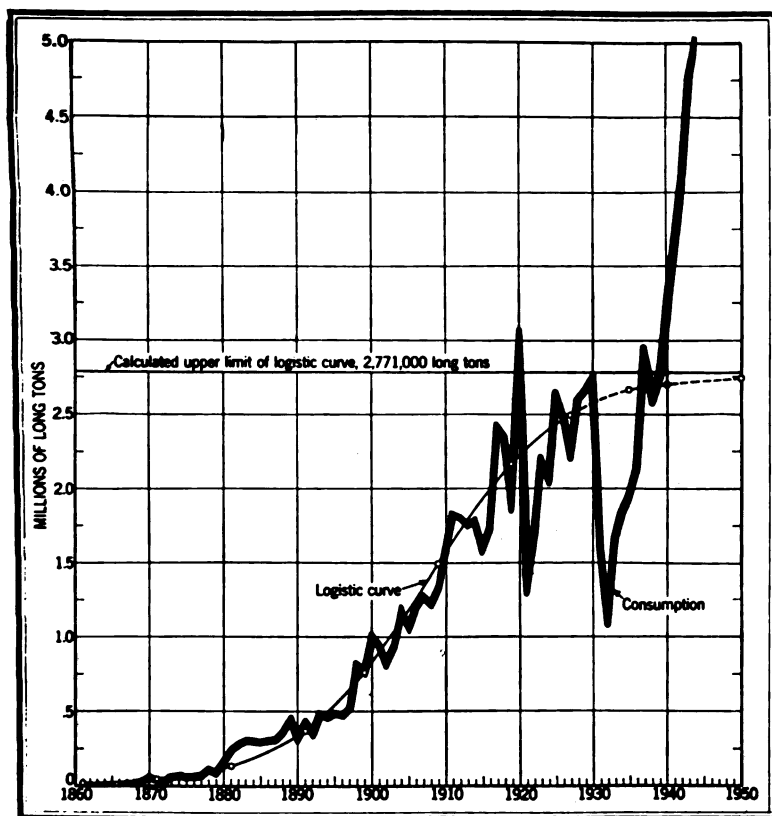


FIGURE 2.—Consumption of phosphate rock in the United States, 1867-1944.

the fluctuations across the curve representing the growth line of domestic consumption and the present position of the consumption far above the normal.

PRICES

Maximum prices for Florida land-pebble phosphate rock and Tennessee brown-rock phosphate were originally established by the Office of Price Administration in October 1942 (Maximum Price Regulation 240). Amendment 3 to this regulation, effective December 3, 1943, increased Tennessee producers' prices 20 cents a ton. These regulations were operative during the first half of 1944. In Revised Maximum Price Regulation 240, effective July 6, 1944, the Office of Price Administration granted an average increase of 20 cents a ton in producers' maximum prices of Florida land-pebble phosphate rock. With this increase there was announced a revision of the regu-

lations covering Florida land pebble, Florida hard rock, and Tennessee brown phosphate rock, but no changes in prices other than that mentioned. Maximum prices were established for Florida hard-rock phosphate.

Ceiling prices per long ton of Florida and Tennessee unground phosphate rock, f. o. b. cars at mines, by grades, effective July 6, 1944¹

Grades—B. P. L. ² content (percent)	Prices			Grades—B. P. L. ² content (percent)	Prices		
	Florida		Tennessee		Florida		Tennessee
	Land pebble	Hard rock	Brown rock		Land pebble	Hard rock	Brown rock
68/66.....	\$2.20	-----	\$4.50	75/74.....	\$4.20	\$7.85	-----
70/68.....	2.60	-----	5.00	77/76.....	5.20	8.60	-----
72/70.....	3.20	\$7.10	5.50				

¹ Office of Price Administration Revised Maximum Price Regulation 240, July 1, 1944, effective July 6, 1944.

² Bone phosphate of lime.

On February 13, 1945, a price increase of 10 cents a ton, at the miners' level, for Tennessee phosphate rock was announced by the Office of Price Administration, to be effective February 17, 1945 (Amendment 1 to Revised Maximum Price Regulation 240—Phosphate Rock). This action is to make no change in retail prices, purchasers absorbing the increase. This addition to the prices is the estimated cost of an increase in wages given by the Fourth Regional War Labor Board with the approval of the Director of Economic Stabilization to four companies engaged in mining and processing Tennessee phosphate rock.

REVIEW BY STATES

Florida.—New records were set in 1944 for the quantities of land pebble and total Florida phosphate rock sold or used (see fig. 3). However, the quantities of both hard and soft rock marketed in 1944 were considerably less than in 1943. The total quantity of phosphate rock sold or used by producers in Florida was 164,302 long tons more than the former record of 1943. The total value of the rock sold or used in 1944 was greater than in 1943 but was still below the 1920 record value. The average values per ton for all types were higher than in 1943.

There were no hard-rock phosphate-mining operations in Florida in 1944. The Dunnellon Phosphate Mining Co. (P. O. Box 157, Savannah, Ga.), a former producer, reports that it made no output and no shipments in 1944 from its mine in Citrus County, near Hernando, that its plant was dismantled at the outbreak of the war in Europe in 1939, and that it will remain inactive for the duration of the war. J. Buttgenbach & Co. (Box 67, Lakeland, Fla.) and C. & J. Camp, Inc., (Box 608, Ocala, Fla.), operating jointly, dried some hard rock from stock at Fernandina, Fla., and exported a considerable quantity. These two companies were preparing a new mine—the Section No. 12 mine near Hernando—for operation but made no production in 1944. This mine was described by Kibler³ late in the year.

³ Kibler, D. B., Jr., Mining and Preparation of Florida Hard-Rock Phosphate: Min. and Met., vol. 25, No. 454, October 1944, pp. 475-476.

The Federal Trade Commission during the year ordered an investigation of the Florida Hard Rock Phosphate Export Association of Savannah, Ga., and the Phosphate Export Association, New York, N. Y., under the Webb-Pomerene law (Export Trade Act) to determine whether they have entered into agreements and engaged in restraint-of-trade activities in violation of law.

In the land-pebble field, the Pembroke Chemical Corp. (Pembroke, Fla.) did not mine or ship during 1944. The seven other companies usually operating in this field—American Cyanamid Co. (Brewster); American Agricultural Chemical Co. (Pierce); Coronet Phosphate Co.

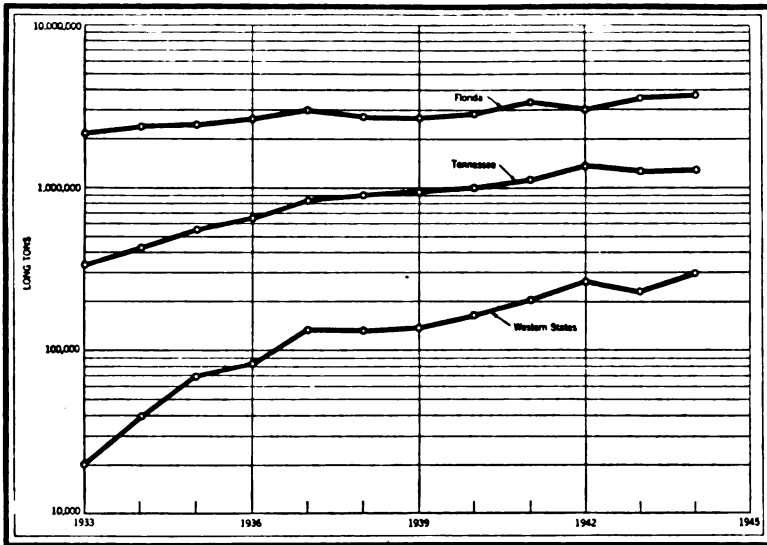


FIGURE 3.—Rate of growth of phosphate rock sold or used by producers, 1933-44, by States.

(Plant City); International Minerals & Chemical Corp. (Mulberry); Phosphate Mining Co. (Nichols); Southern Phosphate Corp. (Ridge-wood); and Swift & Co. Fertilizer Works (Agricola)—mined and shipped land pebble. The Coronet Phosphate Co. is defluorinating phosphate rock and apatite at West Conshohocken, Pa. An article by Fuller and Casler¹⁰ on the mining of land-pebble phosphate rock, and one by Swainson¹¹ on the washing and concentration of the same type of rock appeared late in 1944.

A new Bucyrus-Erie walking dragline excavator, reportedly the largest phosphate dragline ever built, was purchased in 1944 by the International Minerals & Chemical Corp., and is to be installed at its Peace River mine in 1945. This dragline is projected to have a boom of 215 feet with a 20-cubic yard bucket.

Field-test comparisons of colloidal phosphate and superphosphate as sources of phosphorus for potato growing were described.¹²

¹⁰ Fuller, R. B., and Casler, E. T., Mining Pebble Phosphate Rock in Florida: *Min. and Met.*, vol. 25, No. 454, October 1944, pp. 466-468.

¹¹ Swainson, S. J., Washing and Concentrating Florida Pebble Phosphate: *Min. and Met.*, vol. 25, No. 454, October 1944, pp. 469-474.

¹² Brown, B. E., Chukka, J. A., Hawkins, Arthur, and Campbell, J. C., Field Comparisons of Colloidal Phosphate and Superphosphate as Sources of Phosphorus in Potato Fertilizers: *Am. Potato Jour.*, vol. 21, 1944, pp. 241-249.

Florida phosphate rock sold or used by producers, 1940-44, by kinds

Year	Hard rock			Soft rock ¹		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1940	22,367	\$100,353	\$4.49	41,845	\$102,508	\$2.45
1941	38,116	211,049	5.54	47,750	132,472	2.77
1942	70,014	396,527	5.66	48,470	155,345	3.20
1943	34,128	201,241	5.90	71,171	254,995	3.58
1944	22,500	138,952	6.18	60,087	259,523	4.32

Year	Land pebble			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1940	2 2,780,800	\$7,538,316	\$2.71	2 2,845,012	\$7,741,177	\$2.72
1941	3,279,706	9,890,510	3.02	3,365,572	10,234,031	3.04
1942	2,893,756	8,826,705	3.05	3,012,240	9,378,577	3.11
1943	3,483,194	11,633,241	3.34	3,588,493	12,089,477	3.37
1944	3,670,208	13,136,472	3.58	3,752,795	13,534,947	3.61

¹ Includes material from waste-pond operations.² Includes sintered matrix.

Tennessee.—According to reports from producing companies, the tonnage of phosphate rock sold or used by Tennessee producers in 1944 (plus a small quantity of apatite from Virginia) was slightly greater than in 1943. The phosphate rock sold or used—all brown rock, except the Virginia apatite and a little blue rock withdrawn from its stocks and used by the Tennessee Valley Authority—was about 15,000 tons greater than in 1943. The total value was likewise greater.

Tennessee brown-rock phosphate was mined in 1944 by the Tennessee Valley Authority (Columbia, Tenn.) and by several private companies: Armour Fertilizer Works (Room 350, Hurt Building, Atlanta, Ga.), Federal Chemical Co. (634 Starks Building, Louisville, Ky.), Harsh Phosphate Co. (Route 4, Murfreesboro Road, Nashville, Tenn.), Hoover & Mason Phosphate Co. (8 South Michigan Ave., Chicago, Ill.), International Minerals & Chemical Corp. (20 North Wacker Drive, Chicago, Ill.), Monsanto Chemical Co. (1700 South Second Street, St. Louis, Mo.), and Virginia-Carolina Chemical Corp. (Richmond, Va.).

The treatment of phosphate rock in Tennessee was described in articles by Grissom ¹³ and by Wustrack. ¹⁴

According to the annual report of the Tennessee Valley Authority for the fiscal year ended June 30, 1944, a total of 319,000 tons of phosphatic raw materials was received at Muscle Shoals from Tennessee during the year, more than half of which came from the TVA Columbia (Tennessee) field phosphate plants. These plants recovered nearly 203,000 tons of phosphate sands, of which 165,500 tons were shipped to the furnaces at Muscle Shoals, where the nodulizing kilns produced

¹³ Grissom, R. J., Mining and Washing Phosphate Rock in Tennessee: *Min. and Met.*, vol. 25, No. 454, October 1944, pp. 477-480.

¹⁴ Wustrack, O. H., Phosphate Production Problems: *Rock Products*, vol. 47, No. 11, November 1944, pp. 52-53, 55; No. 12, December 1944, pp. 60-61, 109-110, 129; vol. 48, No. 1, January 1945, pp. 196-197, 221-223; No. 2, February 1945, pp. 82, 84, and 99.

189,000 tons of nodules for the furnaces—an increase of 15 percent over the previous fiscal year. No additional phosphate lands were acquired during the fiscal year, but options were taken on three tracts in Williamson County containing an estimated 1,309,000 tons of phosphatic matrix.

The output of elemental phosphorus increased 29 percent from 18,900 tons in the fiscal year 1943 to 24,438 tons in 1944, and shipments for direct military use increased from 12,350 tons to more than 19,000. Installation was begun of a new and slightly larger furnace to produce phosphorus to replace the last unit which produced phosphoric acid, so that the total output of the plant could be used for military phosphorus.

Over-all production of concentrated superphosphate and calcium metaphosphate decreased markedly from that of the previous year owing to increased demands for elemental phosphorus by the Chemical Warfare Service. Less than 48,000 tons of the triple superphosphate were produced compared with the fiscal year 1943 production of 60,200 tons. Production of calcium metaphosphate dropped from 7,300 to 2,900 tons. Shipments of triple superphosphate from the Muscle Shoals plant totaled about 51,900 tons and of calcium metaphosphate about 1,000 tons. TVA also produced about 9,000 tons of dicalcium phosphate, to help meet the shortage of phosphate for stock feed, in a plant placed in operation in October 1943.

Late in the fiscal year TVA began construction of a large plant in the Tennessee phosphate field to produce, by a fuel-fired furnace process, fused defluorinated tricalcium phosphate, a material containing about 29 percent P_2O_5 , and suitable for either fertilizer or stock-feed use. In the fiscal year 1944 the pilot plant produced more than 1,000 tons of this product, of which 325 tons were further processed to a form suitable for animal-feed supplement.

There was a great increase in 1944 in production and distribution of granulated calcium silicate slag from the electric furnaces. This slag is of value as a liming material and soil conditioner and in addition contains a small amount of phosphate plant food. Production was 220,000 tons in 1944, and about 243,000 tons were shipped for agricultural use. About 1,200 tons of byproduct potash-phosphorus furnace dust were produced and 500 tons distributed for use in the test-demonstration programs. Production of byproduct ferrophosphorus totaled 1,000 tons.

Miller¹⁵ has described recently the phosphate operations of the Tennessee Valley Authority.

Tennessee phosphate rock (including sintered matrix) sold or used by producers, 1940-44

[Includes apatite from Virginia]

Year	Long tons	Value of mines		Year	Long tons	Value of mines	
		Total	Average			Total	Average
1940.....	994,361	\$3,967,043	\$3.99	1943 ¹	1,309,059	\$5,822,249	\$4.45
1941.....	1,120,358	4,590,965	4.10	1944 ¹	1,324,849	5,975,337	4.51
1942 ¹	1,366,335	6,127,792	4.48				

¹ Includes small quantity of blue rock.

¹⁵ Miller, A. M., *Phosphate Activities of the Tennessee Valley Authority: Min. and Met.* vol. 25. No. 454, October 1944, pp. 492-494.

Virginia.—In 1944 apatite was produced as usual from the Piney River nelsonite deposit. In the early part of the year this property was operated by the Virginia Chemical Corp., a wholly owned subsidiary of Interchemical Corp. Later, after several reported changes in ownership, the Calco Chemical Division of the American Cyanamid Co. acquired the property, which became a unit of that division.

A considerable quantity of apatite from this deposit was defluorinated by the Coronet Phosphate Co. (19 Rector St., New York 6, N. Y.) at the Valley Forge cement plant at West Conshohocken, Pa., for use as feed amendment.

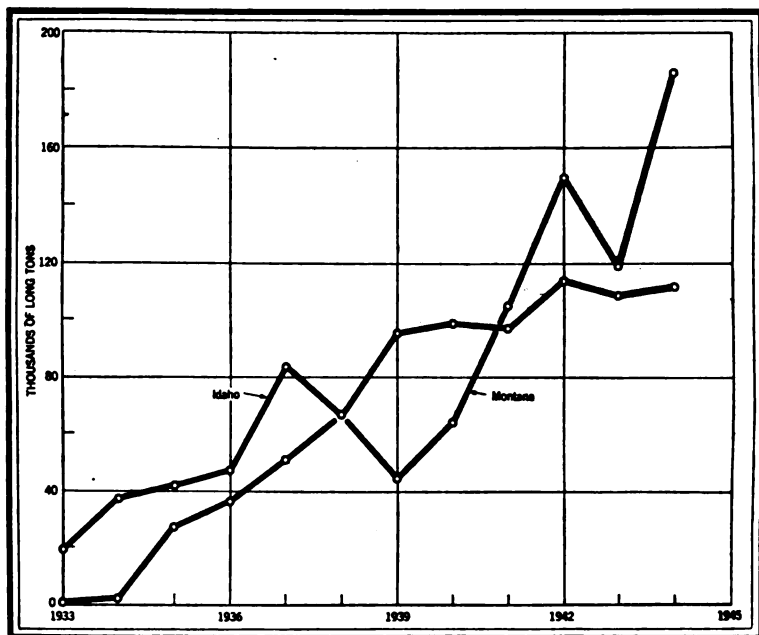


FIGURE 4.—Idaho and Montana phosphate rock sold or used by producers, 1933-44.

Western States.—A new high record for phosphate-rock production in the Western States was set in 1944, the marketed production reaching 298,999 long tons (with a P_2O_5 content of 95,767 tons). The production in 1944 came from Idaho and Montana; Utah was inactive.

Idaho rock sold or used in 1944 (112,565 tons with 35,804 tons P_2O_5 content) was still below the record production of 1942 (114,079 tons). The average P_2O_5 content was 31.80 percent. The same two companies were active in this State in 1944 as in 1943 and 1942. By far the larger of these—the Anaconda Copper Mining Co.—operated its No. 3 mine at Conda, Caribou County. Most of the Conda shipments in 1944 went to Anaconda, Mont., for conversion to superphosphate. Much smaller quantities were used for the manufacture of phosphate chemicals, for direct application to soil, for stock and poultry feed, and for fertilizer filler. Some was exported for acidulating. The other producer (the Teton Phosphate Co., Boise, Idaho)

mined phosphate rock from its Bennington mine in Bear Lake County near Montpelier. This material was ground in the company plant and sold for direct application to soil.

Montana was the largest phosphate-rock producer of the Western States group in 1944, as in recent years, its lead in phosphate rock sold or used over Idaho increasing to 73,869 tons. Its total marketed output in 1944 (186,434 tons with a P_2O_5 content of 59,963 tons) exceeded its record of 1942 (150,402 tons) by 24 percent; the average P_2O_5 content was 32.16 percent. Three mining companies operated in the State in 1944. The Montana Phosphate Products Co. of Trail, British Columbia—largest producer in 1944 in the Western States—operated its Anderson, Graveley, and Anaconda mines and also its leases (Great Falls 076740, 081920, 077348, and 076890) in Powell County, Mont. Most of the mined product was exported to the Consolidated Mining & Smelting Co. at Trail, but a considerable quantity was sold in the United States. The International Minerals & Chemical Corp., which in 1942 acquired the Federal lease of the North-western Improvement Co. (St. Paul, Minn.), in the Douglas Creek area, Granite County, Mont., carried on considerable development work at the mine in 1944. It mined a few thousand tons of phosphate rock and treated it in a large test mill recently erected at Sherryl, on the Philipsburg branch of the Northern Pacific Railway about 7 miles from the mine, producing a considerable tonnage of higher-grade concentrates. However, no sales or shipments of the material were made in 1944. Lee H. Skeels, trustee for Soluble Phosphates, Ltd., Maxville, Granite County, Mont., mined a small tonnage at the mine near Maxville in 1944 but made no shipments during the year.

No phosphate rock was produced in Utah in 1944. The Garfield Chemical & Manufacturing Corp., Salt Lake City, Utah, which mined and shipped phosphate rock in 1942 from a Federal lease near Spanish Fork, Utah County, for use in pig-iron blast furnaces, made no production in 1943 or 1944.

Some interest was shown during the year in phosphate-rock deposits near Cokeville and in the Wind River Mountains, Wyoming.

Several articles have appeared recently descriptive of phosphate-rock deposits and industry of the Western States.¹⁶

Western States phosphate rock sold or used by producers, 1940-44

Year	Idaho			Montana		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1940.....	99,088	\$441,598	\$4.46	64,239	\$184,844	\$2.88
1941.....	97,274	444,154	4.57	105,108	318,588	3.03
1942.....	114,079	511,249	4.48	150,402	572,464	3.81
1943.....	108,916	561,630	5.16	119,764	488,665	4.08
1944.....	112,565	584,400	5.19	186,434	761,745	4.09

¹⁶ Johnson, A. C., and Davis, C. W., War Development Proves Large Vanadium Reserves: Eng. and Min. Jour., vol. 146, No. 4, April 1945, pp. 105-107.

Norris, E. M., Underground Mining of Phosphate Rock at Conda, Idaho: Min. and Met., vol. 25, No. 454, October 1944, pp. 481-485.

Gilbert, Geoffrey, Operations of Montana Phosphate Products Co.: Min. and Met., vol. 25, No. 454, October 1944, pp. 486-487.

Western States phosphate rock sold or used by producers, 1940-44—Continued

Year	Utah			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1940.....				163,327	\$626,442	\$3.84
1941.....	1,340	\$8,535	\$6.37	203,722	771,277	3.79
1942.....	1,184	7,410	6.26	265,665	1,091,123	4.11
1943.....				228,680	1,050,295	4.59
1944.....				296,999	1,346,145	4.50

FOREIGN TRADE

Data on imports and exports of phosphate rock are shown in the following tables.

Phosphate rock and phosphatic fertilizers imported for consumption in the United States, 1940-44

Fertilizer	1940		1941		1942		1943		1944	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Apatite.....					179	\$1,025	6,114	\$61,890	6,090	\$52,758
Phosphates, crude, not elsewhere specified.....	2,953	\$19,536	4,340	\$32,816	3,586	23,862	40,391	315,268	117,324	952,374
Ammonium phosphates, used as fertilizer.....	44,782	1,959,900	55,430	2,483,756	25,521	1,150,319	39,274	1,827,294	82,092	3,942,544
Bone dust, or animal carbon, and bone ash, fit only for fertilizing.....	27,676	618,538	27,607	622,731	7,855	213,970	573	24,244	14,785	463,053
Guano.....	785	17,164	15,394	460,370	3,128	159,799	8,591	526,173	4,365	278,857
Slag, basic, ground or unground.....	452	4,766			1	10	3	56		
Precipitated bone, fertilizer grade.....	1,141	38,225			23	851	75	2,730		

Phosphate rock¹ exported from the United States, 1940-44

Year	Long tons	Value	Year	Long tons	Value
1940.....	751,495	\$3,845,495	1943.....	358,010	\$2,871,136
1941.....	1,019,960	5,738,859	1944.....	438,133	3,460,916
1942.....	528,716	3,348,341			

¹ 1940: Excludes sintered matrix, which is included under "Other phosphate materials." 1941-44: Excludes "Phosphate rock: Florida: Other (including soft rock, colloidal and sintered matrix)," which is included under "Other phosphate materials."

Phosphate rock¹ exported from the United States, 1940-44, by countries

HIGH-GRADE HARD ROCK

Country	1940		1941		1942		1943		1944	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Australia.....									3,997	\$21,983
Brazil.....			201	\$3,500						
Canada.....	64,542	\$394,576	110,658	667,324	157,318	\$969,111	102,759	\$596,457	183,828	989,559
Cuba.....	22	210								
Panama.....	673	3,365								
Portugal.....	8,990	60,673								
Sweden.....	10,365	72,625								
United Kingdom ¹			45,754	285,062	80,273	497,080	42,815	272,547	17,914	121,400
	84,592	531,449	156,613	955,886	237,591	1,466,191	145,574	869,004	205,739	1,132,942

LAND PEBBLE

Country	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Australia.....							24,457	\$128,628	27,011	\$163,983
Belgian Congo.....	3,500	\$28,000								
Canada.....	87,112	440,346	103,827	\$800,951	97,951	\$909,986	129,913	1,522,182	166,050	1,926,142
Eire.....	6,200	34,100			6,697	46,879	18,204	137,336	5,447	47,280
Hungary.....	5,261	27,884								
Italy.....	33,315	210,286								
Japan.....	218,456	813,095	72,722	274,981						
Liberia.....			28	288						
New Zealand.....							13,248	72,864	33,886	190,569
Nigeria.....	1,500	12,000								
Norway.....	2,001	15,007								
Portugal.....	24,837	136,593	32,490	187,866						
Sweden.....	11,536	74,290								
Union of South Africa.....	51,311	282,211	55,345	314,658	3,209	18,969				
United Kingdom ¹	218,872	1,220,721	598,935	3,204,229	183,178	906,316	26,614	141,122		
Yugoslavia.....	3,002	19,513								
	666,903	3,314,046	863,347	4,782,973	291,125	1,882,150	212,436	2,002,132	232,394	2,327,974

¹ 1940: Excludes sintered matrix, which is included under "Other phosphate materials." 1941-44: Excludes "Phosphate rock; Florida; Other (including soft rock, colloidal and sintered matrix)," which is included under "Other phosphate materials."

¹ United Kingdom of Great Britain and Northern Ireland.

High-grade hard-rock phosphate¹ exported from the United States, 1943-44, by customs districts

Customs district	1943		1944	
	Long tons	Value	Long tons	Value
Dakota.....	32	\$1,287	25	\$1,155
Florida.....	42,815	272,547	21,911	143,383
Michigan.....	739	5,947	359	2,990
Montana and Idaho.....	98,292	570,601	183,112	981,487
St. Lawrence.....			49	575
Washington.....	3,696	18,622	283	3,352
	145,574	869,004	205,739	1,132,942

¹ Includes Florida high-grade hard rock and Tennessee, Idaho, and Montana phosphate rock.

Other phosphate materials¹ exported from the United States, 1940-44

Year	Long tons	Value	Year	Long tons	Value
1940.....	11,924	\$201,047	1943.....	862	\$94,391
1941.....	22,988	262,015	1944.....	1,677	78,789
1942.....	5,257	292,934			

¹ Includes bone ash, dust, and meal; animal carbon for fertilizer; basic slag; sintered matrix, etc.

WORLD PRODUCTION

The following table gives available figures on production of phosphate in various countries in recent years.

*World production of phosphate rock, 1939-44, by countries, in metric tons*¹

[Compiled by B. B. Waldbauer]

Country ¹	1939	1940	1941	1942	1943	1944
Algeria.....	2 450,000	(²)	446,535	331,428	76,798	(²)
Australia:						
New South Wales.....	17	20	31	118	(²)	(²)
South Australia.....		254	8,597	14,182	12,976	(²)
Western Australia.....		39	21			(²)
Canada.....	142	325	2,256	1,147	1,316	353
Chile (apatite).....	9,014	32,000	29,123	24,909	37,924	(²)
China.....	2 8,000	(²)	(²)	(²)	(²)	(²)
Christmas Island, Straits Settlements (exports).....	177,972	241,826	(²)	(²)	(²)	(²)
Eire.....	(²)	(²)	(²)	16,444	17,252	(²)
Egypt.....	547,538	183,182	111,708	328,440	315,566	(²)
India, British.....	185	(²)	81	337	(²)	(²)
Indochina.....	35,694	22,266	(²)	(²)	(²)	(²)
Madagascar.....	4 6,600	495	(²)	(²)	(²)	(²)
Makatea Island (exports).....	160,680	173,177	(²)	(²)	(²)	(²)
Morocco, French.....	1,702,973	731,971	511,537	728,923	815,898	(²)
Nauru and Ocean Islands ³	1,244,170	1,263,385	(²)	(²)	(²)	(²)
Netherlands Indies.....	18,777	34,085	(²)	(²)	(²)	(²)
Netherlands West Indies: Curacao (exports).....	64,072	6,047	111,995	(²)	(²)	(²)
New Zealand.....					9,389	(²)
Palestine.....	(²)	(²)	2	2,818	5,384	(²)
Seychelles Islands (exports).....	23,545	14,613	(²)	(²)	(²)	(²)
South-West Africa.....		869	(²)	59	164	(²)
Spain.....	10,320	15,781	13,846	15,232	15,722	16,168
Sweden (apatite).....	6,267	(²)	(²)		2 150,000	(²)
Tanganyika Territory.....	132	9	33	25	269	(²)
Tunisia.....	1,627,912	1,187,823	1,076,118	879,743	334,678	(²)
U. S. S. R. (apatite).....	(²)	(²)	2 2,000,000	(²)	(²)	(²)
United States (sold or used by producers).....	3,817,368	4,066,943	4,764,921	4,718,780	5,208,508	5,462,938
World production (estimate).....	11,500,000	9,800,000	(²)	(²)	(²)	(²)

¹ In addition to countries listed Angaur Island, Austria, Belgium, Brazil, Estonia, France, Germany, Italy, Japan, New Caledonia, Philippine Islands, Poland, Rumania, and Taiwan produce phosphate rock, but data of output are not available.

² Estimate.

³ Data not available. For 1939 and 1940, estimate included in total.

⁴ Exports.

⁵ Exports during fiscal year ended June 30 of year stated.

A comprehensive description of phosphate industries of foreign countries was given by F. C. Noyes, of the Phosphate Export Association.¹⁷

TECHNOLOGIC DEVELOPMENTS

Papers on various developments in phosphate-rock technology that have been published in recent months are listed below.¹⁸

¹⁷ Noyes, F. C., Phosphate Rock Industry of Foreign Countries: Min. and Met., vol. 25, No. 454, October 1944, pp. 495-506.

¹⁸ Reynolds, D. S., Hill, W. L., and Jacob, K. D., Dilute Hydrochloric Acid as a Solvent for Phosphates with Special Reference to Defluorinated Phosphates and Other Materials Used as Phosphorus Supplements for Livestock: Jour. Assoc. Off. Agric. Chemists, November 1944, pp. 559-571.

Chemical Industries, Phosphorus Pentoxide Makes Fluorine-Resistant Glass: Vol. 55, No. 7, December 1944, p. 938.

Mason, H. S., Extinguishing White Phosphorus Fires: Chem. and Eng. News, vol. 23, No. 1, Jan. 10, 1945, p. 40.

Frear, G. L., Ogg, E. F., and Hull, L. H., Preferential Oxidation of Phosphorus in Presence of Carbon Monoxide: Ind. and Eng. Chem., ind. edit., vol. 36, No. 10, October 1944, pp. 927-933.

Science News Letter, New Glass Able to Resist Hydrofluoric Acid: Vol. 47, No. 1, Jan. 6, 1945, p. 7.

Chemical and Metallurgical Engineering, Chlorophosphate Process for Dicalcium Phosphate: Vol. 51, No. 2, February 1944, p. 213. (Abstract of paper by E. J. Fox and K. G. Clark, U. S. Dept. of Agriculture, presented before Am. Chem. Soc., Pittsburgh, Pa., Sept. 6-10, 1943.)

Frear, G. L., Deese, E. F., and Lefforge, J. W., Calcium Metaphosphate, Effect of Impurities on Fusibility, Citrate Solubility, and Hygroscopicity: Ind. and Eng. Chem., ind. edit., vol. 36, No. 9, September 1944, p. 835.

Hill, W. L., Faust, G. T., and Reynolds, D. S., The Binary System $P_2O_5-2CaO.P_2O_5$: Am. Jour. Sci., vol. 242, No. 9, September 1944, pp. 45-477; No. 10, October 1944, pp. 542-562.

SUPERPHOSPHATES

The following tables give the outstanding features of the superphosphates industry in the United States from 1942 to 1944.

Salient statistics of the superphosphate industry in the United States, 1942-44

	1942	1943	1944
Production ¹ short tons..	5, 144, 484	6, 292, 955	6, 692, 368
Shipments, ¹ total..... do.....	3, 961, 362	3, 935, 293	3, 951, 402
To mixers..... do.....	1, 916, 772	3, 935, 293	3, 951, 402
To other acidulators (including exchange transfers)..... do.....	541, 225		
To all others (including Government agencies)..... do.....	1, 503, 365		
Stocks in manufacturers' hand, Dec. 31 ¹ do.....	1 973, 224	791, 385	794, 778
Exports of superphosphates..... long tons..	165, 092	239, 779	183, 859
Imports of superphosphates..... do.....	16, 659	2, 554	1, 217
Sales of phosphate rock by producers for superphosphate production long tons..	3, 242, 689	3, 631, 786	3, 681, 274

¹ Bureau of the Census, Monthly Statistics, Superphosphate Industry, 18 percent available phosphoric acid.

² Stocks of 1,008,139 short tons shown at beginning of January 1943 in Monthly Statistics for that month.

Superphosphates (acid phosphates) exported from the United States, 1943-44, by countries

Country	1943		1944	
	Long tons	Value	Long tons	Value
Africa: British East Africa.....	2, 107	\$73, 660	1, 460	\$64, 831
Brazil.....	6, 099	109, 329	6, 290	109, 384
Cameroon.....	116	6, 141		
Canada.....	95, 089	1, 738, 201	88, 797	1, 685, 595
El Salvador.....	308	7, 410		8, 365
India and Dependencies.....	149	6, 415	2, 750	92, 048
New Zealand.....			5, 241	28, 829
United Kingdom ¹	124, 782	5, 009, 863	55, 373	2, 300, 148
Venezuela.....	133	3, 735	98	2, 585
West Indies:				
British:				
Bahamas.....	139	2, 725	139	3, 848
Leeward Islands.....	400	10, 297	120	3, 064
Trinidad and Tobago.....	202	4, 087	101	2, 143
Other British.....	54	1, 342	521	11, 640
Cuba.....	10, 077	216, 018	21, 989	541, 450
Haiti.....	4	67	6	162
Other countries.....	120	4, 846	609	16, 537
	239, 779	7, 194, 136	183, 859	4, 870, 629

¹ United Kingdom of Great Britain and Northern Ireland.

Superphosphates (acid phosphates) imported for consumption in the United States, 1942-44, by classes

[All from Canada]

Class	1942		1943		1944	
	Long tons	Value	Long tons	Value	Long tons	Value
Normal (standard) (not over 25 percent P ₂ O ₅ content).....	5, 965	\$80, 409	252	\$4, 678	1, 212	\$24, 420
Concentrated (treble) (over 25 percent P ₂ O ₅ content).....	10, 694	300, 342	2, 242	63, 515	5	156
Ammoniated.....			60	3, 698		
	16, 659	380, 751	2, 554	71, 891	1, 217	24, 576

Several articles relating to the superphosphates industry appeared in 1944.¹⁹

BASIC SLAG

No recent figures for production of basic slag are available for the United States or for any foreign country. None was imported into the United States in 1944.

¹⁹ Mehring, A. L., Double Superphosphate: U. S. Dept. of Agriculture Circ. 718, 1944, 24 pp.
Jacob, K. D., and Armiger, W. H., Field Experiments with Alkylation-Acid Superphosphate: Jour. Am. Soc. Agronomy, vol. 36, No. 4, April 1944, pp. 281-286.
Miller, E. V., and Jacob, K. D., Agronomic Value of Alkylation-Acid Superphosphate as Indicated by Greenhouse and Laboratory Experiments: Jour. Am. Soc. Agronomy, vol. 36, No. 4, April 1944, pp. 274-280.
Fox, E. J., Reynolds, D. S., Jacob, K. D., and Hill, W. L., Thermal Defluorination of Superphosphate: Am. Fertilizer, vol. 101, No. 7, Oct. 7, 1944, p. 24; abstract of paper read before Am. Chem. Soc., New York City, Sept. 11-15, 1944.

TALC, PYROPHYLLITE, AND GROUND SOAPSTONE ¹

By BERTRAND L. JOHNSON AND DOROTHY I. MARSH

SUMMARY OUTLINE

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GENERAL CONDITIONS

Mined production and sales of talc, pyrophyllite, and ground soapstone declined in 1944 from the high levels of 1943, according to reports from the producers. The total value of sales was likewise

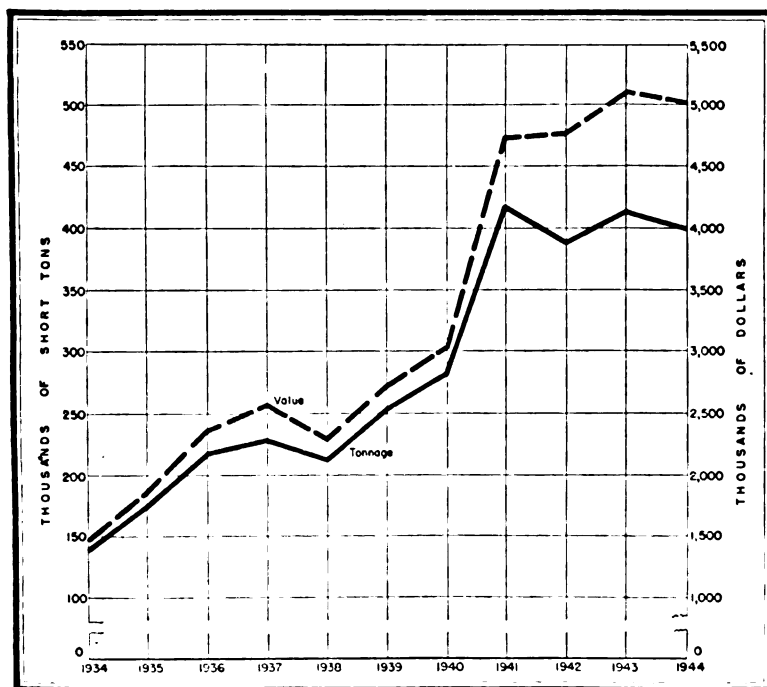


FIGURE 1.—Sales of domestic talc, pyrophyllite, and ground soapstone, 1934-44.

slightly less than the record high value of 1943. (See fig. 1.) Only sales of crude material increased either in quantity or value. All classes of imports increased in 1944 over 1943 in both quantity and

¹ Soapstone sold in slabs or blocks is included in the chapter on Stone.

value. Exports of "talc, steatite, soapstone, and pyrophyllite, crude and ground" were higher in quantity but lower in value.

Pyrophyllite is included with talc in this chapter because of its resemblance to talc in certain physical properties and because it is interchangeable with talc in some uses, although during recent years certain specialized uses for pyrophyllite have been developed. It is a hydrous aluminum silicate, whereas talc is a hydrous magnesium silicate. Production and sales figures for pyrophyllite for 3 years are now available.

Salient statistics of the talc, pyrophyllite,¹ and ground-soapstone industries in the United States, 1943-44

	1943		1944	
	Short tons	Value	Short tons	Value
Mined:				
Total.....	436, 249	(²)	418, 228	(²)
Used by producers.....	382, 668	(²)	353, 209	(²)
Sold by producers:				
Crude.....	30, 200	\$289, 563	³ 45, 654	³ \$514, 476
Sawed and manufactured.....	1, 669	316, 973	938	223, 924
Ground.....	380, 999	4, 514, 878	352, 271	4, 279, 062
	412, 868	5, 121, 414	398, 863	5, 017, 462
Imports for consumption:⁴				
Crude and unground steatite and French chalk....	408	12, 195	696	60, 137
Cut and sawed.....	1	40	132	20, 539
Ground, washed, or pulverized.....	6, 201	64, 815	7, 650	88, 207
	6, 610	77, 050	8, 478	168, 983
Exports:				
Talc, steatite, soapstone, and pyrophyllite, crude and ground.....	10, 693	236, 268	10, 755	229, 293
Powder—talcum (in packages), face, and compact..	(⁵)	756, 024	(⁵)	1, 328, 890
		992, 292		1, 558, 183

¹ In 1943: Mined, 64,198 short tons. Sold—crude, 5,432 tons, \$34,306; ground, 56,710 tons, \$460,485; total, 62,142 tons, \$494,791. In 1944: Mined, 67,252 short tons. Sold—crude, 5,083 tons, \$52,343; ground, 60,560 tons, \$504,739; total, 66,243 tons, \$557,082.

² Data not available.

³ Includes pinites from Nevada.

⁴ Exclusive of "manufactures, n. s. p. f., except toilet preparations," as follows: 1943, \$20; 1944, \$25. Quantities not available.

⁵ Quantity not recorded.

Thirteen States reported sales of talc, pyrophyllite, or ground soapstone in 1944. Texas was the only new producer. The Eastern States furnished the greater part of the total domestic sales in 1944, and most of the remainder came from the Southwest—southeastern California and southwestern Nevada.

The steatite talc situation eased during the year, and at the end of the year there was a considerable stock pile and no shortage for current needs. However, the supply situation of fibrous talc, greatly needed for camouflage paints, became acute. The lower-grade talcs were also in short supply. A shortage of block talc for metal workers' marking crayons was relieved by increased production of extruded talc crayons.

A topographic and geologic map of the Gouverneur talc district, New York, the largest talc-producing district in the United States, was issued by the Geological Survey early in 1945. An area about 10 miles long and 2½ miles wide is shown in which highly metamorphosed gneisses and marbles of the Grenville series (pre-Cambrian) are in-

truded by pre-Cambrian granites and gabbros. Zones of tremolite-talc rock occur in the Grenville marble.

Descriptions of talc deposits in Montana and Vermont were published during the year.¹

Pyrophyllite was in short supply early in 1944 owing to the increased demand for it as an insecticide carrier, but increased production facilities relieved the situation later in the year.

POSTWAR OUTLOOK

The return to peacetime conditions after the cessation of World War II undoubtedly will reduce the domestic demand for talc, pyrophyllite, and ground soapstone. There will also be changes in importance of the relative sources of supply. Domestic production may be expected to be less and imports greater, but probably not sufficiently so as to offset the decline in domestic production. Sales for certain war-stimulated uses—such as for nonreflecting paints for ship camouflage, for insecticides for foreign service, for foundry facing, and for metal-workers' crayons for the iron and steel industry—may drop considerably. Other newly developed wartime uses applicable to peacetime conditions may help to maintain sales. War-developed extruded-talc metal-workers' crayons, however, although supplementing sawed crayons in wartime, could cut into the peacetime demand for crayons of that type.

According to Newcomb²:

Steatite may replace mica in electronic equipment. Improved production methods in civilian industries will find many new applications for electronic controls, so that postwar demand for steatite may reasonably be expected to exceed the prewar rate of production. An annual demand for 6 or 7 million dollars worth of steatite is a realistic estimate.

Only one producing company is as yet handling talc by flotation processes to increase the grade of the product, but other companies are reported as showing an interest in flotation, and the beneficiation of domestic talcs to make them suitable for radio insulators may yet form an important source of steatite talc.

Pyrophyllite is reported to be an ideal carrier or diluent for the chemical DDT for insecticides in typhus areas, and for rotenone, pyrethrum, and nicotine in the manufacture of agricultural insecticides. Its use in this application probably will increase when the active ingredients become available.

With the end of the war in Europe, import trade in talc of steatite and cosmetic grades from various European countries undoubtedly will revive further. (See fig. 2.) Stoppage of the Asiatic phase of the war will likewise release Manchurian and other Asiatic talcs for importation into the United States.

SALES

In 1944 both the quantity and value of domestic talc, pyrophyllite, and ground soapstone sold or used were less than in 1943, according to the reports of the producers to the Bureau of Mines; the average value of the material, however, was slightly higher.

¹ Bureau of Mines, Johnny Gulch Talc Deposit, Madison County, Mont.: War Minerals Rept. 343, 1944, 7 pp.; Mad River Talc Mine, Washington County, Vt.: War Minerals Rept. 222, 1944, 22 pp.

² Newcomb, Rexford, Jr., The Ceramic Industry, Now and Postwar: Bull., Am. Ceram. Soc., vol. 24, No. 2, Feb. 15, 1945, pp. 46-55.

Talc, pyrophyllite,¹ and ground soapstone sold by producers in the United States, 1940-44, by classes

Year	Crude			Sawed and manufactured		
	Short tons	Value at shipping point		Short tons	Value at shipping point	
		Total	Average		Total	Average
1940.....	17,724	\$118,424	\$6.68	1,894	\$140,565	\$74.22
1941.....	43,823	303,839	8.99	4,186	308,467	73.69
1942.....	33,837	303,166	8.96	1,505	370,631	246.27
1943.....	30,200	289,563	9.59	1,669	316,973	189.92
1944.....	45,654	514,476	11.27	938	223,924	238.73

Year	Ground			Total		
	Short tons	Value at shipping point		Short tons	Value at shipping point	
		Total	Average		Total	Average
1940.....	261,757	\$2,749,331	\$10.50	281,375	\$3,008,320	\$10.69
1941.....	368,360	3,999,586	10.86	416,369	4,701,892	11.29
1942.....	352,621	4,080,279	11.57	387,963	4,754,076	12.25
1943.....	380,999	4,514,878	11.85	412,868	5,121,414	12.40
1944.....	352,271	4,279,062	12.15	398,863	5,017,462	12.58

¹ In 1943: Crude, 5,432 tons, \$34,306; ground, 56,710 tons, \$460,485; total, 62,142 tons, \$494,791. In 1944: Crude, 5,683 tons, \$52,343; ground, 60,560 tons, \$504,739; total, 66,243 tons, \$557,082 (exclusive of pinites).

² Includes pinites from Nevada.

Sales by States.—In 1944 New York continued to be the leading producer by a wide margin, although sales were less than in 1943. The total quantity of North Carolina talc, pyrophyllite, and ground soapstone sold or used in 1944 was greater than the previous high of 1943. Sales of California rock exceeded the previous record of 1941. North Carolina was the principal State marketing pyrophyllite, but small quantities are reported to have come from California and Nevada.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1943-44, by States

State	1943		1944	
	Short tons	Value	Short tons	Value
California.....	58,003	\$912,291	65,191	\$1,054,312
Georgia.....	35,210	396,031	30,425	363,342
Maryland.....	(1)	(1)	17,130	161,222
Nevada.....	11,791	171,351	9,590	150,325
New York.....	136,291	2,003,080	(1)	(1)
North Carolina.....	65,698	580,106	69,892	645,156
Vermont.....	56,458	658,471	60,692	724,556
Washington.....	1,998	11,822	3,288	34,103
Other States ¹	47,419	388,262	142,655	1,684,446
	412,868	5,121,414	398,863	5,017,462

¹ Included under "Other States"; Bureau of Mines not at liberty to publish figures separately.

² Includes pinites.

³ 1943: Maryland, Montana, New Mexico, Pennsylvania, and Virginia. 1944: Montana, New Mexico, New York, Pennsylvania, Texas, and Virginia.

MARKETS

Six industries—paint, ceramics, rubber, roofing, paper, and insecticides—took 72 percent of the domestic sales of talc, pyrophyllite, and ground soapstone in 1944, according to reports from producers to the Bureau of Mines. Of these six, as tabulated, the rubber industry alone showed percentage and quantitative increases. Other uses than those titled in the table showed a marked increase over 1943. The quantity for which uses were not reported was also larger.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1943-44, by uses

Use	1943		1944	
	Short tons	Percent of total	Short tons	Percent of total
Paint.....	129,238	31	110,767	28
Ceramics.....	47,900	12	31,932	8
Rubber.....	48,994	12	51,833	13
Roofing.....	47,500	12	45,535	11
Paper.....	34,449	8	27,161	7
Toilet preparations.....	17,682	4	15,965	4
Insecticides.....	24,462	6	21,454	5
Foundry facings.....	10,348	3	6,703	2
Crayons.....	1,446	(¹)	1,358	(¹)
Other uses reported ²	29,528	7	40,016	10
Use not reported.....	21,321	5	46,109	12
	412,868	100	398,863	100

¹ Less than 0.5 percent.

² 1943: Chemical war service, refractory, plaster, insulation, bleaching, mine dust, textile, and other minor uses; 1944: Chemical war service, refractory, plaster, plastics, bleaching, textile, and other minor uses.

³ Includes plinite.

PRICES

Quoted prices on ground domestic talc per ton, f. o. b. works, were unchanged from those given in the Talc, Pyrophyllite, and Ground Soapstone chapter in Minerals Yearbook, 1942 (p. 1385). According to the Oil, Paint and Drug Reporter of May 14, 1945, these prices were:

California: \$17.50 to \$43.

New York: Fibrous, coarse, off-color, \$13.

Fine, 325-mesh, 93 to 94 percent, \$13 to \$18; 98 to 99.5 percent, \$15.25 to \$19.25; 99.85 to 99.95, \$17 to \$21.

Pennsylvania: \$11 to \$13.50.

Vermont: \$14.

Canadian talc, bags, carlots, per ton, \$24 to \$30.

The prices on pyrophyllite have changed slightly from 1943. According to the same journal these were, in May 1945: Standard, 200-mesh, carlots, bulk, mines, per ton, \$10 to \$11.50; 325-mesh, same basis, \$13.00 to \$13.90; No. 3, 200-mesh, carlots, mines, \$9.50; 325-mesh, same basis, \$11.50.

The average values of all grades of talc, pyrophyllite, and ground soapstone in the past 5 years, as reported to the Bureau of Mines by producers, are given in the table under Sales.

Specific dollar-and-cent ceiling prices for four grades of crude talc produced in Esmeralda County, Nev., announced by the Office of Price Administration on November 13, 1944, became effective on November 16, 1944 (Amendment 62 to Order A-1 under Maximum

Price Regulation 188—effective November 16, 1944). The prices established, based as nearly as possible on price levels existing in March 1942, were:

	Maximum price per ton, f.o.b. Zurich, Sw.
Grades:	
No. 1.—Selected Cosmetic Talc.....	\$15.25
No. 2.—Mine-Run White Talc.....	13.00
No. 3.—Mine-Run Talc (Blue or Blue and White Mix).....	10.25
No. 4.—Talc Filler (Blue Talc).....	8.00

Prices of talc produced in other parts of the country are governed by Maximum Price Regulation 188, which has a base pricing period of March 1942.

Producers of pyrophyllite who could qualify as being unable to make and sell their product at existing maximum prices were provided by the Office of Price Administration with a method of applying for price adjustment after August 24, 1944. (Amendment 17 and Order 50 modifying Order A-2 under Maximum Price Regulation 188—both effective August 24, 1944.) The Office of Price Administration was to determine to what extent, if any, increases resulting from adjusted producers' ceilings may be passed on by resellers of the commodity.

DEVELOPMENTS IN THE INDUSTRY

According to Newcomb,³ there are now 27 steatite-insulator manufacturing plants as compared with 5 before the war. In spite of the fact that the manufacture of steatite insulators requires much closer tolerances and radically different production technique, a number of plants normally making electrical porcelain, wall tile, and other products have successfully converted to their manufacture. These plant conversions, involving relatively little new equipment, have made possible the production of 21.6 million dollars worth of steatite products in 1943 as compared with only 1.6 million dollars worth in 1939.

The Tennessee Valley Authority reports⁴ that it

developed a method for making talc pencils by bonding waste talc. The pencils are in demand for metal marking, particularly by the Navy in its shipbuilding program and by the steel industry. Hitherto, talc pencils could be sawed only from solid blocks and less than 5 percent of the producers' run-of-mine talc could be used.

Wollastonite (CaSiO_3) was suggested as a possible substitute for talc as a mineral filler in a letter from R. Van L. Burnham dated November 4, 1944. A deposit in Essex County, N. Y., was described early in 1944.⁵

Carl⁶ has described tests on the firing and heating properties of high- and low-grade block talc. Talc samples from three States—California, Maryland, and Montana—and two foreign countries were

³ Newcomb, Rexford, Jr., *The Ceramic Industry, Now and Postwar*: Bull. Am. Ceram. Soc., vol. 24, No. 2, Feb. 15, 1945, pp. 46-55.

⁴ Tennessee Valley Authority, *Annual Report for Fiscal Year Ended June 30, 1944*: 1944, p. 56.

⁵ Broughton, J. G., and Burnham, K. D., *Occurrence and Uses of Wollastonite from Whillsboro, N. Y.*: Am. Inst. Min. and Met. Eng., Tech. Pub. 1737, 1944, 8 pp.

⁶ Carl, H. F., *Study of Firing Failure in Massive Talc*: Bureau of Mines Rpt. of Investigation 3800, 1945, 9 pp.

studied for composition, texture, grain size, and structure, and their behavior under firing conditions in an electric furnace was observed.

Heizer and Treganza⁷ have described in detail the sources of steatite, talc, and soapstone used by the Indians of California and the varied uses to which these materials were put.

Burnham and Tuttle⁸ have discussed the effect of composition on the ability of glazed dishes to withstand thermal-shock treatment ordinarily received in cooking. Of the bodies studied, the best results were obtained with those containing approximately 10 percent of New York talc and also with a small amount of calcined clay substituted for potters' flint.

Lamar⁹ has correlated the differential shrinkage of fired steatite pieces with the particle shape of the raw talc used in their manufacture. It was found that the more irregular in shape the talc particles the greater the differential shrinkage, and a method is given for assigning arithmetical values ("specific shape factors") to various particle shapes, depending on their deviation from sphericity.

Science News Letter¹⁰ reports that talc is being used as a firebox lining in boilers and locomotives in the Soviet Union instead of the customary firebrick.

The procedure used by the Eastern Magnesia Talc Co. in the flotation of talc in its mill at Johnson, Vt., was described by Franz.¹¹

Experiments described by White¹² are said to

indicate that, although wide variations in the particle size distribution of steatite talcs have a bearing on the firing shrinkage when the talc is incorporated in a body, the differences in grinding obtained in commercial talcs are not of great importance when proper milling practice is employed.

The laboratory and plant procedures used for the control of steatite raw material and the talc-blending system at the plant of the Stupakoff Ceramic & Manufacturing Co., Latrobe, Pa., was described by Staley, Prescott, and Long.¹³

• FOREIGN TRADE ¹⁴

Imports.—The declining trends of recent years in the quantity and value of total imports of talc, steatite, or soapstone, and French chalk was reversed in 1944, and increases are reported not only in the totals but also in all of the reported classes. As usual, the imports were largely of materials "ground, washed, powdered, or pulverized, except toilet preparations." Canada was the chief source of the ground material, and India of the other classes. (See fig. 2.)

⁷ Heizer, R. F., and Treganza, A. E., Mines and Quarries of the Indians of California: California Jour. Mines and Geol., vol. 40, No. 3, July 1944, pp. 291-359.

⁸ Burnham, Forrest, and Tuttle, M. A., Influence of Variable Amounts of New York Talc, Flint, and Calcined Clay on Serviceability of Glazed Cooking-Ware Bodies: Jour. Am. Ceram. Soc., vol. 28, No. 3, Mar. 1, 1945, pp. 72-75.

⁹ Lamar, R. S., Particle Shape and Differential Shrinkage of Steatite Talc Bodies: Jour. Am. Ceram. Soc., vol. 27, No. 11, Nov. 1, 1944, pp. 317-320.

¹⁰ Science News Letter, Talc Used as Lining for Fire boxes in Boilers: Vol. 46, No. 19, Nov. 4, 1944, p. 296.

¹¹ Franz, Hemming, Flotation of Talc: Bull. Am. Ceram. Soc., vol. 23, 1944, pp. 470-472.

¹² White, J. S., Particle-Size Distribution of Steatite Talc: Jour. Am. Ceram. Soc., vol. 27, 1944, pp. 320-323.

¹³ Staley, F. R., Prescott, F. R., and Long, R. E., Control of Raw Material for Steatite Manufacture: Bull. Am. Ceram. Soc., vol. 24, No. 1, Jan. 15, 1945, pp. 3-6.

¹⁴ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

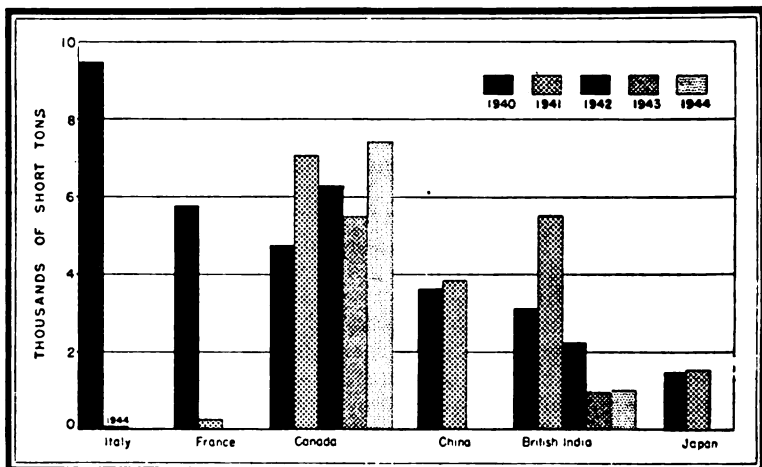


FIGURE 2.—Talc, steatite, or soapstone, and French chalk imported for consumption in the United States 1940-44, by leading countries.

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1940-44, by classes

Year	Crude and unground		Ground, washed, powdered, or pulverized, except toilet preparations		Cut and sawed		Total		Manufactures, n. s. p. l., except toilet preparations (value)
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
1940.....	93	\$1,479	28,145	\$455,049	125	\$20,739	28,363	\$487,267	\$21,586
1941.....	341	5,780	18,225	225,857	71	10,611	18,637	242,248	11,701
1942.....	286	5,753	8,492	94,687	(¹)	36	8,778	100,476	2,704
1943.....	408	12,195	6,201	64,815	1	40	6,610	77,050	20
1944.....	696	60,137	7,650	88,207	132	20,639	8,478	168,963	25

¹ Less than 1 ton.

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1943-44, by classes and by countries

Country	Crude and un-ground		Ground, washed, powdered, or pulverized, except toilet preparations		Cut and sawed		Total		Manufactures, n. s. p. l., except toilet preparations (value)
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
1943									
Brazil.....	5	\$160			1	\$40	6	\$200	
Canada.....			5,659	\$57,623			5,659	57,623	
China.....									\$12
India and Dependencies.....	403	12,035	542	7,192			945	19,227	
United Kingdom ¹									8
	408	12,195	6,201	64,815	1	40	6,610	77,050	20
1944									
Brazil.....	10	159					10	159	
Canada.....	8	800	7,333	75,279	19	5,900	7,360	81,979	
China.....									25
India and Dependencies.....	641	54,972	293	10,496	113	14,739	1,047	80,207	
Italy.....	37	4,206	24	2,432			61	6,638	
	696	60,137	7,650	88,207	132	20,639	8,478	168,963	25

¹ United Kingdom of Great Britain and Northern Ireland.

Exports.—The quantity of "talc, steatite, soapstone, and pyrophyllite, crude and ground," exported from the United States in 1944 is stated to have been slightly greater than in 1943 but did not quite reach the all-time record of 1941. The value, however, was less than in 1943. The value of "powders—talcum (in packages), face and compact" exported in 1944 was again reported to exceed a million dollars.

Talcum and other powders exported from the United States, 1940-44

Year	Description	Short tons	Value
1940.....	(Talc, steatite, and soapstone, crude and ground..... {Powders—talcum (in packages), face, and compact.....	9, 402 (1)	\$167, 992 945, 530
1941.....	(Talc, steatite, soapstone, and pyrophyllite, crude and ground..... {Powders—talcum (in packages), face, and compact.....	10, 889 (1)	216, 440 1, 229, 280
1942.....	(Talc, steatite, soapstone, and pyrophyllite, crude and ground..... {Powders—talcum (in packages), face, and compact.....	9, 246 (1)	191, 900 678, 313
1943.....	(Talc, steatite, soapstone, and pyrophyllite, crude and ground..... {Powders—talcum (in packages), face, and compact.....	10, 693 (1)	236, 268 756, 024
1944.....	(Talc, steatite, soapstone, and pyrophyllite, crude and ground..... {Powders—talcum (in packages), face, and compact.....	10, 755 (1)	229, 293 1, 328, 890

¹ Quantity not recorded.

WORLD PRODUCTION

Only a few figures for the production of talc, pyrophyllite, and ground soapstone, in various countries in recent years are yet available. Such as are obtainable are shown in the following table.

World production of talc, pyrophyllite, and soapstone, 1937-44, by countries, in metric tons¹

[Compiled by B. B. Waldbauer]

Country ¹	1937	1938	1939	1940	1941	1942	1943	1944
Argentina.....	208	80	303	1, 168	1, 975	4, 770	(²)	(²)
Australia:								
New South Wales.....	526	597	612	754	1, 153	1, 353	1, 814	(²)
South Australia.....	991	973	1, 115	1, 349	2, 972	2, 577	3, 336	(²)
Tasmania.....								
Western Australia.....						308	74	(²)
Canada.....	³ 11, 301	³ 9, 846	³ 11, 924	21, 583	31, 417	27, 096	23, 735	³ 12, 700
China (Manchuria) (exports).....	111, 140	81, 215	93, 772	⁴ 72, 495	(²)	(²)	(²)	(²)
Egypt.....	2, 266	1, 251	833	2, 212	5, 229	1, 875	2, 054	(²)
Finland.....	881	(²)	(²)	(²)	(²)	(²)	(²)	(²)
France.....	56, 300	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Germany:								
Austria (exports).....	14, 089	5, 625	(²)	(²)	(²)	(²)	(²)	(²)
Bavaria.....	7, 790	6, 805	(²)	(²)	(²)	(²)	(²)	(²)
Greece.....	1, 838	1, 293	1, 003	(²)	(²)	(²)	(²)	(²)
India, British.....	13, 249	18, 888	22, 616	(²)	(²)	(²)	(²)	(²)
Indochina.....	428		400	305	(²)	(²)	(²)	(²)
Italy.....	45, 714	53, 511	71, 363	(²)	(²)	(²)	(²)	(²)
Morocco, French (exports).....	841	1, 702	(²)	(²)	(²)	(²)	(²)	(²)
Newfoundland.....	(²)	1, 605	(²)	284	508	(²)	2, 439	-----
Norway.....	24, 701	23, 703	(²)	(²)	(²)	(²)	(²)	(²)
Rumania.....	1, 976	2, 256	(²)	(²)	(²)	(²)	(²)	(²)
Spain ⁵	3, 021	8, 438	5, 545	28, 643	29, 148	36, 497	14, 238	(²)
Sweden.....	7, 937	6, 797	7, 195	7, 569	(²)	(²)	(²)	(²)
Tanganyika Territory.....		38	5	6	(²)	(²)	(²)	(²)
Union of South Africa: Transvaal.....	376	1, 554	449	1, 757	1, 830	1, 985	5, 344	⁶ 1, 340
United Kingdom.....			46	1, 074	4, 532	2, 231	2, 815	(²)
United States ⁷	208, 650	193, 025	230, 402	255, 258	377, 722	351, 952	374, 546	361, 841
Uruguay (exports).....	437	952	1, 111	1, 699	1, 867	3, 618	1, 637	⁸ 2, 280

¹ In addition to countries listed talc or pyrophyllite is reported produced in Brazil, Bulgaria, Chile, Madagascar, New Zealand, and U. S. R. R., but data on production are not available.

² Data not available.

³ Excludes soapstone, which is reported only by value and was as follows: 1937, \$40,513; 1938, \$35,038; 1939, \$41,471; 1944, \$186,261. Soapstone is sold in the form of both blocks and powder.

⁴ January to September, inclusive.

⁵ Includes steatite, as follows:—1937: 500 tons; 1938: 3,480; 1939: 5,545; 1940: 17,191; 1941: 18,948; 1942: 24,859; 1943: 9,741 tons.

⁶ January to June, inclusive.

⁷ Talc, pyrophyllite, and ground soapstone sold by producers; includes also pinit in 1940, 1941, 1942, and 1944.

⁸ Estimate.

Canada.—Developments in the Canadian talc and soapstone industry in 1943 have been described as follows:¹⁵

¹⁵ Canada Department of Trade and Commerce, Dominion Bureau of Statistics, Mining, Metallurgical, and Chemical Branch, The Talc and Soapstone Industry, 1943: Ottawa, Canada, 1944. Data largely from report, Talc and Soapstone in 1943, by Bureau of Mines, Ottawa, Canada.

Mine shipments of soapstone and talc reported in 1943 by operators in the province of Quebec amounted to 14,204 tons worth \$135,469. Production of the higher grades of talc in Canada is confined chiefly to the province of Ontario, and the 1943 shipments totaling 11,959 tons, valued at \$131,216, were made almost entirely from a deposit located near Madoc, Hastings County. Included in the Ontario output was a relatively small tonnage of talc obtained from a property situated near Ompah in Frontenac County. In British Columbia, crude talc imported from the United States was treated in a Vancouver mill. From October to December development work was carried on at a talc deposit located at Red Mountain in the Kootenay National Park of British Columbia; this operation is known as the Lava Talc Project and was conducted by the Wartime Metals Corp., a trial shipment was made to the United States [Foreign] Economic Administration.

* * * * *

During 1943 there were eight firms reported as active in the industry, five in the province of Quebec, two in Ontario, and one in British Columbia; of these, six made commercial shipments. * * *

Annual production of ground talc in Canada in the 5-year period 1939-43, inclusive, ranged from 16,000 to 32,000 tons, these figures including also material classed in the statistical records as soapstone, part of which was ground in mills other than those of primary producers. All of the output came from Ontario and Quebec.

Most of the material from Ontario consists of white, foliated talc, which occurs as veins in crystalline dolomitic limestone of the Madoc area, Hastings County, where an established talc industry has existed for the past 40 years. Total output from the Madoc area to the end of 1943 is about 400,000 tons. Since 1937, Canada Talc, Ltd., operating the Conley and Henderson mines, has been the only important producer. W. C. Spry & Co., in recent years has been milling a small tonnage of finely schistose, cream-colored talc in the plant of Canada Slate Products, about a mile north of Madoc. The crude rock is trucked in from a deposit near Ompah, in Frontenac County, 65 miles distant.

In Quebec, the talc produced is also of the foliated type, but it occurs in bands in highly metamorphosed basic rocks, mainly serpentine and pyroxenite, and is often associated with bodies of soapstone, an impure talcose rock. It contains much iron, and varies rather widely in carbonate content. It yields a slightly off-color, gray powder, and is used chiefly in the rubber, paper, and roofing trades. The entire production is obtained from the Eastern Townships, mainly from the Thetford Mines area, and there are also a mine and a mill at Highwater close to the Vermont boundary. All of Canada's output of sawn soapstone blocks, sold chiefly for use in the alkali recovery furnaces of domestic kraft mills, and also of talc crayons, comes from the Thetford Mines area. Some of the sawing dust from these operations is sold to domestic roofing firms, and a large tonnage of quarry and sawing waste is shipped to the grinding plant of Pulverized Products, Limited, 4820 Fourth Avenue, Rosemount, Montreal.

* * * * *

Many grades of ground talc are marketed, and the price range is wide. Value is dependent upon purity (determined by freedom from lime and gritty or iron-bearing substances, slip, and color), particle shape, and fineness of grinding, the specifications of which vary in the different consuming industries. Roofing and foundry talcs are the cheapest grades, the trades in these being satisfied with coarser, gray or off-color material, often soapstone powder or sawing dust, which sells at about \$5 to \$7 a ton, f. o. b. rail. Domestic gray talc, suitable for rubber and paper use, sold in 1943 for an average of \$7.50 to \$9 per ton. White talc from the Madoc area was quoted at \$8 to \$10 for the coarser grades, \$12 to \$18 for finer mesh sizes, and \$44 for minus 400-mesh material.

A detailed description of the mining and milling of talc by Canada Talc, Ltd., in the Madoc (Ontario) district was published late in 1944,¹⁶ and a description of the Broughton soapstone quarry in the Thetford Mines district of the Province of Quebec in March 1945.¹⁷ The manufacturing methods of the new Canadian Steatite Co., Ltd., plant at Georgetown, Ontario, using California talc, are described by Phillips and Rue.¹⁸

¹⁶ McLaren, D. C., Mining and Milling Talc. An Account of Operations in the Madoc District, Ontario Canadian Min. Jour., vol. 65, No. 12, December 1944, pp. 833-840.

¹⁷ Rowe, R. C., Mining Soapstone. The Broughton Quarry: Canadian Min. Jour., vol. 66, No. 3, March 1945, pp. 153-156.

¹⁸ Phillips, J. G., and Rue, C. V., Manufacture in Canada of Steatite Electrical Insulators for High-Frequency Purposes: Jour., Canadian Ceram. Soc., vol. 13, 1944, pp. 11-24.

FLUORSPAR AND CRYOLITE

By HUBERT W. DAVIS AND GERTRUDE N. GREENSPOON¹

SUMMARY OUTLINE

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FLUORSPAR

SUMMARY

Impressive as was the performance in 1943, when 405,600 tons of finished fluorspar were produced, operators bettered that record by producing 2 percent more in 1944—an amount slightly larger than the unprecedented consumption, which for the first time exceeded 400,000 tons. Finished production and shipments (413,700 and 413,781 short tons, respectively) in 1944 were each 2 percent greater than in 1943, the previous record year. Moreover, finished production and shipments were each 1 percent greater than consumption, which was 5 percent more than in 1943. Although Illinois shipments declined 11 percent from the all-time high established in 1943, the State not only maintained its rank as the chief producer in 1944 but supplied 43 percent of the total shipments. After declining for two successive years, shipments from Kentucky turned slightly upward. However, Colorado, New Mexico, Texas, and Utah established new records. Shipments by river or river-rail (69,536 tons) were 39 percent more than in 1943, but lacked 12 percent of equaling the all-time high of 1942. Receipts of foreign fluorspar in 1944 also established a new record, exceeding by 22 percent the previous peak of 1926. Exports—usually small—were insignificant in 1944 and totaled only 1,980 tons.

The Government stock-pile objective of 200,000 tons of fluorspar was approaching attainment, and about 154,000 tons had been delivered toward that goal at the close of 1944; however, of this amount 24,100 tons have been disposed of, leaving a balance of 129,900 tons on December 31. The disposal of Government stocks of strategic minerals, which include fluorspar, is covered in the Surplus Property Act of 1944, Public No. 457, 78th Congress, sec. 22 (a), approved October 3, 1944, from which the following is quoted:

All Government-owned accumulations of strategic minerals and metals, including those owned by any Government corporation, shall be transferred by

¹ Figures on imports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce; those on exports of fluorspar supplied by the producers.

the owning agency, when determined to be surplus pursuant to this Act, to the account of the Treasury Procurement Division and shall be added to the stock pile authorized by the Act of June 7, 1939 (53 Stat. 811), as amended, and shall be subject to its provisions: *Provided*, That contractor inventory shall be so transferred only when the owning agency has taken possession of and determined such inventory to be surplus. * * *

Late in 1944 Kentucky fluorspar operators, upon formal application to and approval by the War Labor Board, were permitted to equalize wage rates with Illinois. The established wage scale in Kentucky is 10 cents an hour less than in Illinois.

The monthly production of metallurgical-grade fluorspar exceeded requirements during most of 1944, and because of the reasonably satisfactory supply and demand relationship the War Production Board on August 12 discontinued the restricted shipping plan in effect since January 1, 1943. Moreover, the restriction on the sale or delivery of standard metallurgical-grade fluorspar, although not rescinded, was relaxed during the latter half of 1944.

Salient statistics of fluorspar in the United States, 1935-44, in short tons

Year	Shipments from domestic mines	Foreign trade		Consumption	Stocks at end of year			
		Imports for consumption	Exports		Consumers' plants	Domestic mines ¹	Government stock pile	Total
1935.....	123, 741	16, 340	313	137, 400	58, 000	40, 043	-----	98, 043
1936.....	176, 877	25, 504	240	182, 400	72, 600	29, 958	-----	102, 558
1937.....	181, 230	37, 063	456	194, 300	90, 100	30, 539	-----	120, 639
1938.....	80, 403	19, 622	788	115, 100	71, 800	34, 996	-----	106, 796
1939.....	182, 771	16, 302	2, 976	176, 800	90, 400	38, 619	-----	129, 019
1940.....	233, 600	11, 873	8, 482	218, 500	102, 100	43, 866	-----	145, 966
1941.....	320, 669	7, 524	12, 184	303, 600	108, 900	31, 997	-----	140, 997
1942.....	360, 316	2, 151	9, 020	360, 800	96, 000	19, 429	-----	115, 429
1943.....	406, 016	43, 769	9, 068	388, 885	105, 933	19, 026	36, 223	161, 182
1944.....	413, 781	87, 200	1, 980	410, 170	98, 446	19, 055	129, 885	247, 386

¹ Finished fluorspar only.

Despite the improved supply-demand position of metallurgical-grade fluorspar in 1944, the domestic steel industry, as in 1943, continued to practice conservation and to study the use of substitutes. The average consumption of fluorspar per long ton of basic open-hearth steel produced dropped from 5.9 pounds in 1943 to 5.7 pounds in 1944. The smaller consumption at steel plants was due to conservation measures, to the use of better-grade fluorspar, to a decline in production of alloy steel, and to the increased use of roll scale; but some substitutes, such as topaz, ilmenite, and salt, were also used in 1944.

According to Steel: ²

Aluminum dross as a substitute for fluorspar affords no advantage. One operator experimenting with salt as a fluorspar substitute found that evaporated salt passed off in fumes, coating the furnace on the outgoing end. Cattle salt fumes off as fast as evaporated. No 2. rock salt gave slightly better results. Recommended practice was the use of 75 percent fluorspar and 25 percent salt.

Although no bauxite is known to have been used as a substitute for fluorspar in the United States, it has replaced fluorspar as a flux in the open-hearth steel works at Port Kembla, Australia. Obtained in

² Steel, Open Hearth and Blast Furnace Groups Set Attendance Record: Vol. 114, No. 18, May 1, 1944, p. 95.

pisolitic form, it is cheap but only about one-third as effective as fluorspar.³ The quantity of bauxite used does not exceed 2 pounds per ton of ingots.

According to Reinartz:⁴

It has been found that, under proper supervision, production (steel) can be increased by the use of slag-control methods because of the more efficient use of smaller charges of flux. This practice will continue to be improved in post-war days.

Production of ceramic-grade fluorspar was again adequate to meet requirements. However, monthly consumption of acid-grade advanced almost steadily during 1944, and as production lagged behind consumption the supply position became worse during the latter part of the year. Moreover, it developed that some of the fluorspar furnished proved unsatisfactory for use in making anhydrous hydrofluoric acid because of excessive sulfur, which could not be coped with in the acid-manufacturing plants. As a result of the unsatisfactory quality of some of the acid-grade shipped, part of the stocks at consuming plants will require further milling before being suitable for the manufacture of anhydrous hydrofluoric acid. To overcome the complaints of inferior quality, steps were taken by such domestic producers to remove the sulfur. The shortage in production was relieved considerably by milling to acid grade some of the Mexican fluorspar in the Government stock pile. The Mexican fluorspar, being of much higher grade than domestic milling ore, lends itself to a higher recovery. Although some flotation concentrates were received from Newfoundland, the product contained excessive moisture which will be removed by drying at a consumer's plant.

Deliveries of fluorspar to consumers in the United States totaled 398,916 short tons in 1944 (387,405 tons from domestic mines, 3,696 tons from Government stock piles, and 7,815 tons from foreign sources); in addition, 24,396 tons of finished fluorspar from domestic mines were delivered to Government stock piles. In 1943 deliveries to consumers totaled 404,658 tons (388,902 tons from domestic mines and 15,756 tons from foreign sources); in addition, 8,070 tons of finished fluorspar from domestic mines were delivered to Government stock piles. Total deliveries to steel plants in the United States decreased to 221,000 tons from 236,425 tons in 1943, but those to hydrofluoric acid plants advanced to 126,991 tons from 123,820 tons; sales to the glass and enamel trades increased substantially.

Maximum base prices of \$30 to \$33 a short ton for metallurgical-grade fluorspar and of \$37 a ton for ceramic and acid grades, established by the Office of Price Administration on July 1, 1943, continued in effect throughout 1944. However, because of the improved supply-demand relationship of metallurgical-grade fluorspar, the selling price was depressed toward the end of the year.

The average composite selling price (\$30.60 a short ton) of all grades of fluorspar (both domestic and foreign) delivered to consumers in the United States was \$1.25 more than in 1943 (\$29.35). The average selling price of all grades of domestic fluorspar shipped in 1944 (\$30.22) established a new peak and was \$1.15 greater than the previous high of 1943. The average selling price f. o. b. Illinois-Kentucky mines, of metallurgical-grade fluorspar shipped to domestic

³ London Mining Journal, vol. 223, No. 5706, Dec. 30, 1944, p. 807.

⁴ Reinartz, L. F., Open-Hearth Steelmaking: Metals and Alloys, vol. 21, No. 1, January 1945, p. 111.

steel plants was \$29.73 a ton (\$28.69 in 1943) and of that shipped to domestic manufacturers of hydrofluoric acid \$36.51 (\$33.86 in 1943).

The total quantity of fluorspar shipped in and imported into the United States from about 1870 through 1944 was approximately 7,226,000 short tons, comprising 6,029,000 tons from domestic mines and 1,197,000 tons from foreign sources. It is noteworthy that, of the total domestic shipments, 1,917,153 tons (32 percent) were shipped during the past 6 years (1939-44).

POSTWAR OUTLOOK

The fluorspar industry will emerge from the war with a demand substantially greater than that during prewar years because of new uses discovered during the war and a growing demand for some of the older uses. However, the possibilities of large imports after the war are a serious threat to the domestic industry, owing to the recent opening of deposits in Mexico, Newfoundland, and Spain, where future production will depend largely on access to United States markets.

Possible substitutes for fluorspar as a flux in steel manufacture have been under study, but so far as known none has been found as efficient for this purpose as fluorspar. Consequently, as heretofore, the steel industry will continue to be the chief consumer of fluorspar. However, some of the conservation measures effected during the war doubtless will be continued. A large expansion in the postwar demand for acid-grade fluorspar, as compared with prewar requirements, will result from the new uses for hydrofluoric acid discovered during the war and from a growing demand in some of its older uses. Two outstanding wartime developments, which have important peacetime possibilities, are the anhydrous hydrofluoric acid alkylation process in aviation-gasoline manufacture and the aerosol insecticide bomb, which uses Freon as a propellant. A greatly increased future demand is anticipated for Freon, used as refrigerant in household and commercial refrigeration plants, air-conditioning systems, and frozen-food lockers. A new unannounced use for hydrofluoric acid, which may rival Freon in making demands on the industry for hydrofluoric acid, has been rumored. A further future demand for fluorspar would develop should studies now under way prove that the addition of fluorine salts to drinking water prevents tooth decay without objectionable effects, such as tooth discoloration. The peacetime requirements of fluorspar for the glass industry, it is believed, will exceed those immediately preceding the war. With respect to the enamel trade, the introduction of a new enamel for direct application on steel, which eliminates the necessity for a ground coat and permits the application of lighter coats of enamel, might result in a decline in future consumption of fluorspar for this use.

The extent of participation by the domestic industry in the postwar demand for fluorspar will depend to a large degree on the rate of duty, which has been lowered 25 percent since January 1, 1939. Between World War I and World War II, Germany, France, and England were the chief exporters of fluorspar to the United States. France is likely to have an exportable surplus after the war. Imports from England have been insignificant during the past 15 years, but as extensive development during the war has reestablished several mines it is

possible that future production may exceed home consumption. Heavy production that began with German rearming no doubt has substantially depleted the reserves in that country. Mexico, Newfoundland, and Spain, small producers before the war, will hereafter undoubtedly occupy prominent positions among the fluorspar-producing countries as a result of intensive development of deposits during the war. Inasmuch as Mexico and Spain are relatively small consumers and Newfoundland is a nonconsumer of fluorspar, future production in these countries will depend largely upon the development of export markets, probably chiefly in the United States. Therefore, it is apparent that a large, exportable surplus of fluorspar will be available in many countries after the war.

Although the wartime selling price of fluorspar will not continue after the war, the higher costs of developing and mining fluorspar at greater depths will undoubtedly prevent the price from dropping to prewar levels.

PRODUCTION AND SHIPMENTS

Production of finished fluorspar totaled 413,700 short tons in 1944, including 156,672 tons of flotation concentrates. However, this production of 413,700 tons includes 17,700 tons of finished fluorspar recovered from milling some crude ore mined before 1944. Consequently, total mine production (expressed in terms of finished fluorspar) was 396,000 tons in 1944 compared with 433,000 tons in 1943. Of the mine production in 1944, 10 mines producing over 10,000 tons each supplied 174,000 tons or 44 percent, 18 mines producing 5,000 to 10,000 tons each supplied 125,000 tons or 32 percent, 31 mines producing 1,000 to 5,000 tons each supplied 63,000 tons or 16 percent, and 23 mines producing 500 to 1,000 tons each supplied 17,000 tons or 4 percent; thus, 82 mines produced 379,000 tons or 96 percent of the total. The remainder (17,000 tons or 4 percent) of the production, in quantities ranging from a few tons to 500 tons, came from an undetermined number of small mines, prospects, waste dumps, and old workings of abandoned mines.

Fluorspar shipments from domestic mines in 1944 were the largest on record and aggregated 413,781 short tons valued at \$12,503,487, representing increases of 2 and 6 percent, respectively, over 1943, the previous peak year. Of the 1944 total, 69,536 tons were shipped by river or river-rail for delivery to consumers as compared with 49,913 tons in 1943.

Illinois (43 percent) and Kentucky (27 percent) supplied 70 percent of the fluorspar shipped in 1944 compared with 76 percent in 1943. Shipments from Illinois and Kentucky were 6 percent less than in 1943 compared with a gain of 28 percent from other producing States.

The average value of all grades of finished fluorspar shipped in 1944 was \$30.22 a short ton (\$1.15 more than the 1943 average).

The following table shows shipments of fluorspar, by States, in 1943 and 1944. (For historical table, see *Minerals Yearbook*, 1941, p. 1401.)

Shipments of fluorspar in 1944 comprised 237,108 tons of fluxing gravel and foundry lump, 153,750 tons of flotation concentrates, 21,331 tons of ground, and 1,592 tons of acid lump. The bulk of the fluxing-gravel and foundry-lump fluorspar was shipped to steel plants and iron foundries, but a comparatively small tonnage moved to plants

Fluorspar shipped from mines in the United States, 1943-44, by States

State	1943			1944		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Illinois.....	198,789	\$6,292,789	\$31.66	176,259	\$5,954,991	\$33.79
Kentucky.....	109,849	3,122,513	28.43	112,791	3,363,788	29.82
Colorado.....	49,145	1,164,868	23.70	65,209	1,604,043	24.60
New Mexico.....	37,050	986,094	26.62	42,973	1,205,630	28.06
Nevada.....	8,653			7,293		
Utah.....	51	188,619	21.34	3,466	252,071	23.27
California.....	134			26		
Texas.....	960	19,281	20.08	4,769	100,381	21.05
Arizona.....	1,328	26,441	19.91	976	21,983	22.52
Tennessee.....	57	1,650	28.95			
Wyoming.....				19	400	21.05
	406,016	11,802,255	29.07	413,781	12,503,487	30.22

making cement, ferro-alloys, nickel, basic refractories, and fluxing compounds, to smelters of secondary metals, and to the Government stock pile. Hydrofluoric-acid plants took 77 percent of the flotation concentrates shipped in 1944; the remainder went to aluminum- and magnesium-reduction works, to steel, ferro-alloy, glass, and enamel plants, to smelters of secondary metals, and to the Government stock pile. About three-fourths of the ground fluorspar was shipped to glass and enamel plants; the remainder moved chiefly to manufacturers of hydrofluoric acid, welding rod, magnesium, and ferro-alloys and to smelters of secondary metals. Except for 20 tons to a steel plant, all the acid-lump fluorspar was shipped to hydrofluoric-acid plants.

The next table shows shipments of fluorspar, by grades and industries, in 1943 and 1944.

Fluorspar shipped from mines in the United States, 1943-44, by grades and industries, in short tons

Grade and industry	1943	1944	Grade and industry	1943	1944
Fluxing gravel and foundry lump:			Flotation concentrates:		
Ferrous.....	215,530	210,930	Ferrous.....	13,351	14,589
Nonferrous.....	3,313	1,264	Nonferrous.....	5,375	4,677
Cement.....	1,084	646	Glass and enamel.....	6,982	13,961
Miscellaneous.....	205	389	Hydrofluoric acid.....	121,985	118,452
Government stock pile.....	4,374	23,824	Miscellaneous.....	673	122
Exported.....	1,945	65	Government stock pile.....	3,696	572
	226,461	237,108	Exported.....	6,664	1,477
				158,724	153,750
Acid lump:			Total:		
Ferrous.....	20	20	Ferrous.....	228,996	225,665
Nonferrous.....	1		Nonferrous.....	10,189	7,421
Hydrofluoric acid.....	547	1,572	Cement.....	1,094	646
	568	1,592	Glass and enamel.....	21,059	29,859
			Hydrofluoric acid.....	123,680	121,064
Ground:			Miscellaneous.....	3,884	2,730
Ferrous.....	95	126	Government stock pile.....	8,070	24,396
Nonferrous.....	1,500	1,480	Exported.....	9,044	1,980
Glass and enamel.....	14,077	15,998		406,016	413,781
Hydrofluoric acid.....	1,150	1,060			
Miscellaneous.....	3,006	2,219			
Exported.....	435	448			
	20,263	21,331			

¹ Includes pelletized gravel.

SHIPMENTS, BY USES

As is evident from the following table, the predominant purchaser of fluorspar is the steel industry, which also consumes substantial quantities of hydrofluoric acid and sodium fluoride, in which fluorspar is the basic material.

Fluorspar shipped from mines in the United States, 1943-44, by uses

Use	1943				1944			
	Quantity		Value		Quantity		Value	
	Percent of total	Short tons	Total	Average	Percent of total	Short tons	Total	Average
Steel.....	54.38	220,809	\$6,006,251	\$27.20	53.01	219,361	\$6,087,077	\$27.75
Iron foundry.....	.84	3,398	85,728	25.23	.98	4,044	109,869	27.17
Glass.....	4.80	19,487	582,173	29.87	6.67	27,174	892,761	32.85
Enamel.....	.39	1,572	50,620	32.20	.65	2,685	90,444	33.68
Hydrofluoric acid.....	30.46	123,680	4,046,231	32.72	29.26	121,084	4,251,686	35.11
Miscellaneous.....	4.91	19,956	598,627	30.00	3.15	13,057	416,672	31.91
Government stock pile.....	1.99	8,070	185,652	23.01	5.90	24,396	589,069	24.15
Exported.....	97.77	396,972	11,555,282	29.11	99.52	411,801	12,437,578	30.20
	2.23	9,044	246,973	27.31	.48	1,980	65,909	33.29
	100.00	406,016	11,802,255	29.07	100.00	413,781	12,503,487	30.22

USES

As figure 1 shows graphically, the steel industry is the chief consumer of fluorspar in the United States. Fluorspar is used as a flux in basic open-hearth and basic electric steel furnaces; a comparatively small quantity is employed in Bessemer-steel furnaces. The second-largest use is in the manufacture of hydrofluoric acid, which is utilized to make artificial cryolite and aluminum fluoride (aluminum raw materials), refrigerating mediums, and insecticides; hydrofluoric acid is also used in the electrolytic refining of metals, the pickling of metals, electroplating operations, the processing of high-octane gasoline, the etching of glassware, frosting electric light bulbs, and as an aid in straw-bleaching processes, as well as for many other purposes. One of the most important wartime developments in aviation-gasoline manufacture is the anhydrous hydrofluoric acid alkylation process, in which hydrogen fluoride is the catalyst instead of the usual sulfuric acid. Another important wartime invention is the new aerosol dispenser, for protection of the Army overseas from malaria mosquitoes, in which Freon, a nonpoisonous gas employed in refrigerating systems, is used. Both developments resulted in greatly increased demand for acid-grade fluorspar in 1943 and 1944. The glass industry, which employs fluorspar as an opacifier and as a flux, ranks third in importance. The enamel industry uses fluorspar as an ingredient in frit; before the war it ranked fourth as a consumer, but because of the restrictions on the manufacture of enamel products it has been a small consumer in recent years. A new enamel for direct application on steel, which eliminates the necessity for a ground coat and permits the application of lighter coats of enamel, has recently been announced.⁵ The steel, hydrofluoric acid, and ceramic industries

⁵ Mackasek, Edward, Porcelain Enamel Steel: Metals and Alloys, vol. 21, No. 1, January 1945, p. 87.
Comstock, G. F., and Wainer, E., New Titanium Steel for Vitreous Enamel: Iron Age, vol. 155, No. 7, Feb. 15, 1945, pp. 60-63, 152-153.

accounted for about 95 percent of the fluorspar consumed in the United States in 1944; the remainder was used chiefly as a flux at iron foundries, magnesium-reduction, aluminum-reduction, and ferro-alloy plants and secondary nonferrous smelters, and in a formula for coating welding rods. More fluorspar was used at iron foundries, magnesium-reduction plants, and nonferrous smelters in 1944 than in 1943, but less was consumed at ferro-alloy and aluminum-reduction plants and by makers of welding rods. The use of fluorine in drinking water to prevent tooth decay continued to receive much publicity in 1944.

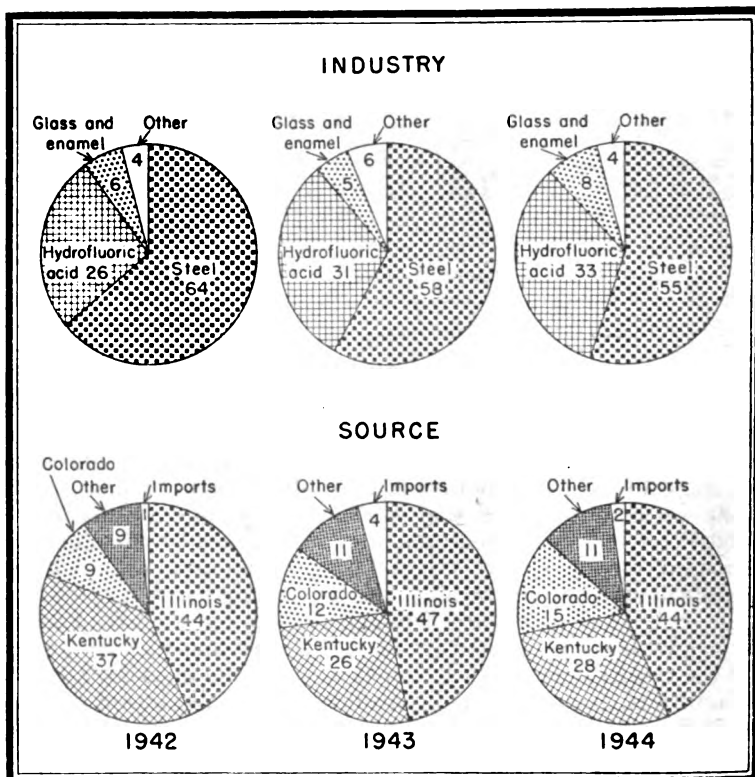


FIGURE 1.—Fluorspar sales (domestic and foreign) to consumers in the United States, 1942-44, by consuming industries and by sources.

SPECIFICATIONS

The chief commercial grades of fluorspar are metallurgical, ceramic, and acid. The standard chemical specification for metallurgical grade is a minimum of 85 percent calcium fluoride and a maximum of 5 percent silica and 0.3 percent sulfur; it contains 72½ percent effective calcium fluoride. Lead and zinc are also undesirable and should be held to a minimum. However, because of a scarcity of metallurgical-grade fluorspar, the Office of Price Administration, effective August 30, 1943, prohibited the sale or delivery of metallurgical-grade fluorspar containing more than 60 percent effective

calcium fluoride unless the Steel Division of the War Production Board had certified in writing to the producer that the purchaser required a higher-grade fluorspar. With the improved supply-demand position this restriction was relaxed during the latter half of 1944. The standard chemical specification for acid-grade fluorspar is a minimum of 98 percent calcium fluoride and a maximum of 1 percent silica, but a base analysis of 97½ percent calcium fluoride and 1½ percent silica was established by the Office of Price Administration on July 1, 1943. Over 0.02 percent sulfur is considered undesirable, and the moisture content should be less than 1 percent and preferably nil. As there has been no shortage in the supply of ceramic-grade fluorspar, no change was made by the Office of Price Administration in the standard specification, which is a minimum of 95 percent calcium fluoride and a maximum of 2½ percent silica.

CONSUMPTION AND CONSUMERS' STOCKS

The following tables give data on consumption and consumers' stocks of fluorspar.

Fluorspar (domestic and foreign) consumed and in stock in the United States, 1943-44, by industries, in short tons

Industry	1943			1944		
	Consumption	Stocks at consumers' plants Dec. 31	In transit to consumers' plants Dec. 31	Consumption	Stock at consumers' plants Dec. 31	In transit to consumers' plants Dec. 31
Basic open-hearth steel.....	205,676	61,195	3,008	201,788	56,956	6,566
Electric-furnace steel.....	28,236			27,307		
Bessemer steel.....	236			1,106		
Iron foundry.....	3,378	1,155	104	4,101	1,345	
Ferro-alloys.....	3,882	2,331		3,714	876	
Hydrofluoric acid.....	113,614	27,951	1,443	129,553	27,249	1,325
Primary aluminum.....	2,758	1,008	55	1,487	696	
Primary magnesium.....	3,025	1,026	158	5,594	943	
Glass.....	20,592	6,184	283	27,315	5,621	950
Enamel.....	1,726	1,065	132	2,547	1,202	98
Welding rod.....	2,286	150		1,928	175	1
Cement.....	262	1,046		421	1,278	
Miscellaneous.....	3,214	2,822	348	3,309	2,105	101
	388,885	105,933	5,531	410,170	98,446	9,041

Production of basic open-hearth steel and consumption and stocks of fluorspar (domestic and foreign) at basic open-hearth steel plants, 1940-44

	1940	1941	1942	1943	1944
Production of basic open-hearth steel ingots and castings..... long tons.....	55,038,000	66,056,000	67,821,000	69,695,000	71,387,000
Consumption of fluorspar in basic open-hearth steel production..... short tons.....	143,800	191,300	217,100	205,676	201,788
Consumption of fluorspar per ton of steel made..... pounds.....	5.2	5.8	6.4	5.9	5.7
Stocks of fluorspar on hand at steel plants at end of year..... short tons.....	79,800	84,200	60,400	57,200	53,100

The quantity of fluorspar used per long ton of basic open-hearth steel varies with each plant, each operator, each furnace, and each heat but probably ranges from less than 1 pound to 80 pounds. The average for all plants is 5 to 8 pounds—a relatively small proportion of the furnace charge. From 1921 (the first year for which such data

were collected) to 1940 the average consumption of fluorspar per long ton of steel made declined almost steadily from 8.2 to 5.2 pounds; it increased to 5.8 pounds in 1941 and to 6.4 pounds in 1942—the highest since 1935. However, it declined to 5.9 pounds in 1943 and 5.7 pounds in 1944. The decreased consumption in 1943 and 1944 was due chiefly to conservation measures, although some substitutes were used. Although the basic electric steel industry is a small user of fluorspar compared with the basic open-hearth steel industry, the average consumption of fluorspar (13.3 pounds in 1944) per long ton of basic electric steel made is substantially greater. Moreover, the average consumption of fluorspar per ton of basic electric steel made increased in 1944.

Fluorspar was reported consumed in 40 States and the District of Columbia in 1944, but 3 States—Illinois, Ohio, and Pennsylvania—used 239,584 tons or 58 percent of the total consumption. Illinois, the chief consuming State in 1943, was displaced by Pennsylvania in 1944. Illinois, however, maintained its rank as the largest consumer of fluorspar in hydrofluoric acid in 1944. Pennsylvania again ranked first in consumption of fluorspar in both steel and glass.

The next table shows, so far as possible without revealing the figures of individual companies, the consumption of fluorspar by States in 1943 and 1944.

Fluorspar (domestic and foreign) consumed in the United States, 1943-44, by States, in short tons

State	1943	1944	State	1943	1944
Alabama.....	13,532	11,120	Indiana.....	20,287	26,414
Georgia.....			Kentucky.....	10,924	8,814
Arizona.....			Maryland.....		
Kansas.....	694	609	Massachusetts.....		1,488
Nebraska.....			Rhode Island.....	1,087	
Nevada.....			Michigan.....	15,754	13,706
South Dakota.....	555	322	Minnesota.....	3,629	2,062
Wyoming.....			Wisconsin.....	3,835	3,196
Arkansas.....			Missouri.....	17,749	18,774
Louisiana.....	555	322	New York.....	68,610	69,137
Mississippi.....			Ohio.....	595	3,201
North Carolina.....			Oklahoma.....	1,978	3,162
Florida.....	7,877	10,160	Oregon.....		
California.....			Washington.....		104,608
Colorado.....			Pennsylvania.....	85,371	
Iowa.....	9,627	11,844	Tennessee.....	1,175	1,726
Utah.....			Texas.....	3,708	11,334
Connecticut.....			Virginia.....	311	302
Delaware.....	763	1,317	West Virginia.....	6,068	6,102
District of Columbia.....	26,454	34,924		388,886	410,170
New Jersey.....					
Illinois.....					
	87,702	65,839			

PRICES

Prices fixed by the Office of Price Administration on July 1, 1943, remained in effect in 1944; they were \$30 to \$33 a short ton for metallurgical-grade fluorspar and \$37 a ton for acid and ceramic grades.

STOCKS AT MINES OR SHIPPING POINTS

According to reports of producers, the quantity of fluorspar in stock at mines or shipping points at the close of 1944 totaled 69,883 tons or 40 percent less than in 1943. These stocks comprised 19,055 tons of finished fluorspar and 50,828 tons of crude fluorspar (calculated to be equivalent to 24,000 tons of finished fluorspar).

Stocks of fluorspar at mines or shipping points in the United States, December 31, 1943 and 1944, by States, in short tons

State	1943			1944		
	Crude ¹	Finished	Total	Crude ¹	Finished	Total
Arizona.....					68	68
California.....	150	7	157	150		150
Colorado.....	39,108	892	40,000	4,660	1,033	5,693
Idaho.....	50		50	50		50
Illinois.....	34,079	6,363	40,442	32,507	8,694	41,201
Kentucky.....	6,541	10,498	17,039	2,850	8,055	10,905
Nevada.....		200	200		101	101
New Mexico.....	16,983	573	17,556	10,611	450	11,061
Texas.....		293	293		430	430
Utah.....		200	200		224	224
	96,911	19,025	115,937	50,828	19,055	69,883

¹ The greater part of this crude (run-of-mine) fluorspar must be beneficiated before it can be marketed.

TECHNOLOGIC DEVELOPMENTS

Results of operation of the heavy-media process by three companies in 1944 for treating fluorspar ores were apparently highly satisfactory. With this process, lower-grade ore can be mined and beneficiated than was economical with jigs, treatment costs are lowered, a better concentrate with lower tailing losses is obtained, and production is increased. During 1944 a heavy-media plant was being installed at the Mitchem mine near Keller, Ferry County, Wash., by the Western Minerals Co.; it was expected to be in operation in February 1945. The heavy-media plant of the Rosiclare Lead & Fluorspar Mining Co., which began operating in March 1944, has been described by Cronk.⁶

The Aluminum Ore Co. installed a sulfide circuit in its flotation mill at Rosiclare, Ill., during 1944. The circuit consists of a four-cell flotation machine, complete with conditioners, a filter, and a pump. It removes lead and zinc sulfides ahead of the fluorspar flotation circuit, thus resulting in low-sulfur acid-grade concentrates and a byproduct of lead and zinc sulfides. A problem of lowering the sulfur in the metallurgical-grade fluorspar concentrate of a producer in Colorado was solved by placing a Duplex Denver mineral jig, 8 by 12 inches, with a center draw-off in the mill circuit to treat the total gravel production, amounting to about 20 tons per 24 hours.⁷ The feed, ranging in size from one-fourth inch to 100-mesh, is now delivered to the jig by a dewatering screw conveyor. Fine sulfides are removed in the jig through the wedge-wire lower screen, and a small amount of coarse middlings is removed through the center draw-off openings. Formerly the concentrate recovered on jigs and tables contained 1 to 1.5 percent sulfur, pyrite, and galena, and lesser amounts of other heavy metal sulfides, but since the Denver mineral jig has been in operation the finished gravel fluorspar averages 0.6 to 0.7 percent sulfur.

The Bureau of Mines continued its metallurgical studies on fluorspar. The ore from a number of properties was investigated to determine its amenability to flotation. Further progress was made in perfecting the separation of fluorspar and barite. An investigation of various binders for agglomerating fine fluorspar for metallurgical use was conducted at the Rolla Laboratory.

⁶ Cronk, A. H., Heavy-Media Cuts Costs at a Fluorspar Mill: Eng. and Min. Jour., vol. 146, No. 1, January 1945, pp. 66-68.

⁷ Gisler, H. J., Denver Mineral Jig has Helped Fluorspar Mill Lower Sulphur Content: Mining Record (Denver), vol. 56, No. 7, Feb. 15, 1945, p. 5.

The flotation mill of Minerva Oil Co. near Cave in Rock, Ill., made its initial production in March 1944. The flotation plant of Corod Minerals Corp. near Marion, Ky., was completed but did not produce any fluorspar concentrates. The plants of A. E. Chambers near Forney, Idaho, and American Fluorspar Co. near Albuquerque, N. Mex., noted in the chapter of this series for 1943, were not completed in 1944. The flotation plant of Chaffee County Fluorspar Corp., under construction near Salida, Colo., was expected to be in operation in February 1945. Kramer Mines, Inc., whose flotation mill at Salida, Colo., was destroyed by fire on July 6, 1944, was constructing a new mill near Colorado Springs, Colo.; operation was expected to begin in February 1945. Output of flotation concentrates from domestic ore totaled 156,672 short tons in 1944 compared with 159,758 tons in 1943. However, flotation mills in the United States also recovered 4,855 tons from milling Mexican ore in 1944.

FLUORSPAR INDUSTRY IN 1944, BY STATES

Arizona.—Production in Arizona in 1944, totaling 1,044 short tons, came from mines and prospects in Greenlee, Maricopa, and Yuma Counties; that from Greenlee County was shipped to flotation plants at Deming and Lordsburg, N. Mex., and near El Paso, Tex., and the concentrating mill at Silver City, N. Mex. The concentrates recovered from the fluorspar, rather than the milling ore, have been credited in the statistics to Arizona. The fluorspar from Yuma County was a byproduct from the Sonora lead mine, and part of it was shipped to an iron foundry in California. The fluorspar from Maricopa County came from the Contact and West End Spar mines near Wickenburg, was produced by J. A. Campbell, Isaac Campbell, and A. W. Nickle, and was shipped to steel plants. During the last quarter of 1944, while endeavoring to secure milling ore for its flotation mill at Duncan, the Southwestern Mineral Co. conducted mill tests on the re-treatment of middlings from previous operations, but no commercial concentrates were produced.

California.—Production of fluorspar in California in 1944 was only 19 tons which, together with 7 tons produced in 1943, was shipped to a steel plant. It was produced at the Red Bluff mine near Midland, Riverside County, by E. T. Hermann.

In 1944 some Nevada fluorspar was ground at the plant of the Industrial Minerals & Chemical Co. at West Berkeley and shipped to magnesium-reduction plants, and some Utah fluorspar was ground at the plant of Robinson & Stephens at La Verne and shipped to a glass plant. The ground fluorspar is credited in the statistics to Nevada and Utah.

Colorado.—Reflecting greatly accelerated activity at mines in Boulder and Jackson Counties, shipments from Colorado increased to 65,209 short tons in 1944, a new record and a gain of 33 percent over 1943. The 1944 shipments comprised 39,273 tons of metallurgical-grade fluorspar and 25,936 tons of flotation concentrates.

Production of finished fluorspar in Colorado totaled 65,300 tons in 1944. However, the production includes 11,400 tons of finished fluorspar recovered from treating some crude ore mined previous to 1944. Consequently, total mine production (expressed in terms of finished fluorspar) was 53,900 tons compared with 60,500 tons in 1943.

Output came from Boulder, Chaffee, Jackson, Mineral, and Park Counties; mines in the first three supplied 87 percent of the State total.

During 1944 Harry M. Williamson & Son completed a new surface plant at its Argo mine and retimbered the shaft to the old winze level, 160 feet below the collar. At its Emmett mine the shaft was sunk 90 feet to open the seventh level, which is 556 feet below the shaft collar. Ore is now being mined by shrinkage stoping above the sixth level in the Emmett mine, 456 feet below the collar of the shaft and 374 feet below the tunnel. A caterpillar Diesel engine was installed in the power plant to add to the stand-by power for the winter when there is insufficient water to drive the waterwheel at capacity, and a new brick stack for the drier was also installed at the drying unit. Production of finished fluorspar was 63 percent greater than in 1943 and comprised 59 percent fluxing gravel and 41 percent acid-grade flotation concentrates. The ore treated in the mill came from the company-operated Argo, Brown Spar, and Emmett mines in Boulder County. Some milling ore was sold to the nearby flotation mill of the General Chemical Co.

Production of flotation concentrates at the mill (near Jamestown) of General Chemical Co. was 24 percent greater than in 1943. The output of the mill was shipped to the hydrofluoric-acid plants of the company. The flotation-mill feed comprised ore from the company-operated Alice, Burlington, Chancellor, and Yellow Girl mines in Boulder County, and some purchased ore. This company also operates a flotation mill in New Mexico.

The Colorado Fluorspar Corp., which operates a combination flotation-jig mill and a mine near Salida, Chaffee County, produced 12 percent more finished fluorspar than in 1943. Production in 1944 comprised 51 percent fluxing gravel and foundry lump and 49 percent flotation concentrates.

The flotation mill of Kramer Mines, Inc., near Salida, which started operating in October 1942, was destroyed by fire on July 6, 1944. The company had a flotation mill under construction at Colorado Springs. As a consequence of the fire, production of flotation concentrates in 1944 was 67 percent less than in 1943. The company has mines near Salida and Poncha Springs, Chaffee County, and Northgate, Jackson County; and it is reported to have acquired undeveloped reserves near its new mill in El Paso County.

The American Fluorspar Corp., operating mines near Salida and Poncha Springs (Chaffee County), produced 38 percent less fluxing-gravel fluorspar than in 1943, but its output of milling ore, which is supplied to the Fluorspar Processing Co., was 24 percent more. Considerable development was done at the Aksarben and Dostal mines. The flotation mill of the Fluorspar Processing Co.—on property of the American Fluorspar Corporation—produced 9 percent more fluorspar concentrates than in 1943. A number of improvements were made in the mill, and a laboratory was installed.

Production of fluxing-gravel fluorspar by the Western Fluorspar Corp. was $8\frac{1}{2}$ times that in 1943. The company operates a heavy-media-process plant near Northgate, Jackson County. The new plant began operating in December 1943 and replaced the mill destroyed by fire December 10, 1942. The plant feed in 1944 was divided about equally between ore from current production and ore from stock pile accumulated in 1943, when the plant was under con-

struction. The adjoining Penber fluorspar property was acquired by the Western Fluorspar Corp. in 1944. Some mine-run ore from the Penber mine was produced by M. P. Cloonan in 1944; it was shipped to a cement plant.

The Wagon Wheel Gap mine of the Colorado Fuel & Iron Corporation was operated throughout 1944 as compared with 10 months in 1943; consequently, production was 12 percent greater.

A small quantity of fluorspar was produced in 1944 by Luke E. Smith at a property near Jefferson in Park County.

Idaho.—In the course of development at the Chamac mine near Forney, Lemhi County, A. E. Chambers produced some milling ore in 1944. However, the flotation mill, noted as under construction in the chapter of this series for 1943, presumably was not completed in 1944.

Illinois.—Fluorspar production in Illinois, which reached an all-time high in 1943 after an unbroken 5-year upward trend, declined in 1944; nevertheless, Illinois maintained its rank as the chief producing State. Production of finished fluorspar was 178,600 short tons in 1944; about 98 percent came from Hardin County and 2 percent from Pope County. However, the production includes 1,600 tons of finished fluorspar recovered from treating some crude ore mined before 1944. Consequently, total mine production (expressed in terms of finished fluorspar) was 177,000 tons in 1944 compared with 204,000 tons in 1943. Much Kentucky fluorspar is milled in Illinois, and some Illinois fluorspar is milled in Kentucky; the finished fluorspar so recovered, as well as that shipped, is credited in the statistics to the State of origin. The Argo, Blue Diggings, Crystal, A. L. Davis, W. L. Davis, Dardorff, Douglas, Fairview, West Green, Hillside, Midway-North Boundary-Air Shaft, Minerva, Rose Creek, Rosiclare, and Victory properties supplied about 90 percent of the fluorspar produced in Illinois in 1944; the remainder came from many mines and prospects, including the Austin, Cave in Rock, Daisy-North Daisy, Dimick, East Green, Good Hope, Hawkins, J. W. Hill, Humm, Last Chance, Lead Hill, Lost 40, Red Tipple, Rock Candy Mountain, South Boundary-Deep Shaft, Stewart, Underwood, and Wall.

Shipments of fluorspar from Illinois (176,259 tons) were 11 percent less than the all-time record of 1943 but constituted 43 percent of the total shipped. The 1944 shipments comprised 71,516 tons to steel plants, 81,493 tons to hydrofluoric-acid plants, 14,058 tons to glass and enamel plants, 8,184 tons to iron foundries, nonferrous smelters, aluminum- and magnesium-reduction plants, and ferro-alloy, nickel, and welding-rod manufacturers, and 1,008 tons to Brazil, Canada, and Peru. Of the 1944 total, 41,790 tons were shipped by river or river-rail to consumers compared with 34,643 tons in 1943.

Although producing 18 percent less fluorspar at its flotation mill than in 1943, the Aluminum Ore Co. was again the largest producer in the United States. The mill feed comprised ore from the company-operated Argo, Blue Diggings, Fairview, Good Hope, and Last Chance mines.

In 1944, unlike 1942 and 1943, there were no strikes at the Crystal mine; as a consequence, the Crystal Fluorspar Co. produced 10 percent more fluorspar than in 1943. In 1944 the company did 14,258 feet of diamond and churn drilling, completed 501 feet of

underground development in preparing for extraction of ore, and did 356 feet of prospecting work in extension of its known ore body.

Production of gravel and flotation concentrates by Hillside Fluor Spar Mines was 9 and 5 percent, respectively, more than in 1943. The mill feed comprised ore from the Dimick, Hillside, and Wall mines at Rosiclare, Ill., and the Keystone and Guill mines near Marion, Ky., purchased ore chiefly from the Austin, Cave in Rock, Douglas, Rock Candy Mountain, and Rose Hill mines, and tailings from previous milling operations. Production and shipments of finished fluorspar from the Keystone and Guill mines have been credited in the statistics to Kentucky.

The Victory mine of the Victory Fluorspar Mining Co. produced 26 percent less fluorspar than in 1943. Production in 1944 was hampered by two local strikes.

The flotation mill of the Mahoning Mining Co. produced 10 percent more fluorspar concentrates from domestic ore than in 1943. The mill feed comprised ore from the A. L. Davis, W. L. Davis, Deardorff, East Green, and West Green mines and some purchased ore. Production of finished fluorspar comprised 77.6 percent acid-grade and 22.4 percent pelletized gravel. During 1944 the company acquired the Klondike and Mineral Ridge mines in Livingston County, Ky., where development was in progress. A comparatively small tonnage of Mexican fluorspar was also milled by the company in 1944; the flotation concentrates so recovered, as well as shipped, are not included in the statistics for Illinois.

The Minerva Oil Co., which had been developing a mine and constructing a flotation mill near Cave in Rock, brought both units into production in March 1944. However, from time to time it was necessary to make changes in the mill, and it was not operated at capacity.

The Rosiclare Lead & Fluorspar Mining Co. operated the Daisy-North Daisy, Hawkins, Midway-North Boundary-Air Shaft, Rosiclare, and South Boundary-Deep Shaft in 1944, but the Rosiclare mine was the chief producer. The ore is feed for the company heavy-media-process plant and flotation mill. Production of finished fluorspar of all grades was 11 percent greater, but shipments were 7 percent less than in 1943. Two diamond drills were operated throughout 1944 on the property of the company to find additional ore bodies and unknown veins.

The Fluorspar Products Co. operated the Lead Hill and Stewart mines and milled purchased ore from various properties. Shipments were 56 percent less than in 1943.

The Rose Creek and Douglas mines, operated by Yingling Mining Co., were worked at an increased rate in 1944. Some of the ore was milled by the company, but the bulk was sold to local mills for treatment.

Outstanding among the smaller producers in Illinois in 1944 were the Big Creek Mining Co. (Rock Candy Mountain mine); J. F. E. Austin, Keeling & Conn, and Frailey & Winters (all Austin mines); O. P. Grischy (Cave in Rock and Lead Hill mines); and the mines of the General Finance Corporation. All ore from these operations was sold to local mills.

Kentucky.—Production of fluorspar in Kentucky in 1944 continued the downward trend that began in 1942. Production of finished

fluorspar was 110,300 short tons in 1944. However, the production includes 2,400 tons of finished fluorspar recovered from milling some crude ore mined before 1944. Consequently, total mine production (expressed in terms of finished fluorspar) was 107,900 tons in 1944 compared with 119,000 tons in 1943. Shipments gained slightly, totaling 112,791 tons, but were 21 percent less than the all-time high for 1941. The 1944 shipments comprised 96,326 tons to steel plants, 11,575 tons to glass and enamel plants, 1,998 tons to hydrofluoric-acid plants, 2,797 tons to iron foundries, nonferrous smelters, and cement and miscellaneous plants, and 95 tons to Canada. Of the 1944 shipments, 27,746 tons were shipped to consumers by river or river-rail compared with 15,270 tons in 1943.

Output in Caldwell County came chiefly from the Crook, Eureka, Glass, Hollowell & Hobby, Hughett, and Senator mines.

The Hughett mine of the Hughett Mining Co., near Princeton, was nonproductive after April 11, 1944, and consequently production was 78 percent less than in 1943. Likewise, the Hollowell & Hobby mine of the New York & Kentucky Mining Co., also near Princeton, was closed in April, and output was 61 percent less than in 1943.

The Midland Minerals Corp. operated the Senator mine, near Princeton, at a greatly reduced rate in 1944.

In 1944, as in 1943, the major part of the output in Crittenden County came from a few mines—Babb, Bachelor, Big Four, Blue, Davenport, Eagle (Watson), Keystone, Pigmy, and Tabb. Most of the remainder came from many smaller mines (including the Barnes, Central, Columbia, Cook, Gillless, Green, Hickory Cane, Hodge, Krause, La Rue, Pepper Box, Reiter, Sullinger, Watkins, and Yates) and from numerous prospects; some was reclaimed from waste dumps and old workings of abandoned mines.

The Eagle Fluorspar Co. worked the Eagle (Watson) and Babb mines and produced 39 percent less finished fluorspar than in 1943. Some development was started at the Eagle mine in 1944. Perry & Loyd reworked the Eagle tailings and recovered much fluorspar.

The mill of the United States Coal & Coke Co. produced 20 percent more finished fluorspar than in 1943, but shipments increased 77 percent. The mill feed comprised ore chiefly from the company-operated Tabb mines, but some was from the Big Four mine, owned by the company but operated by Perry & Loyd.

Tonnage and dollar sales by the Kentucky Fluor Spar Co. and affiliates were 29 and 25 percent, respectively, less than those in 1943, which, however, were the largest in their history. The company operates a mill at Marion and, through its mining divisions (Roberts & Frazer and Hettiger & Frazer), operated the C. R. Babb, Carr, and Wright mines in Livingston County and the Pepper Box mine in Crittenden County. About two-thirds of the company supply came from these mines and the remainder chiefly from the Barnes, Gillless, Glass, La Rue, Nancy Hanks, and Watkins.

Production at the Keystone mine of Hillside Fluor Spar Mines was 37 percent less than in 1943. The company acquired the Guill mine in Livingston County in 1944. Although the fluorspar from these mines is finished at the company mill at Rosiclare, Ill., production and shipments are credited in the statistics to Kentucky.

At the Pigmy mine of the Pigmy Corp. (subsidiary of the Rosiclare Lead & Fluorspar Mining Co.) production was 76 percent more than

in 1943. One diamond drill was operated the entire year to find additional ore bodies and unknown veins. A 300-foot shaft, sunk years ago but from which no development had been done, was retimbered to a depth of 200 feet; it will become the main producing shaft for the Pigmy mine on the west side of the property.

Production of finished fluorspar at the Davenport mine of National Fluorspar Co. was slightly less than in 1943.

Output at the Bachelor mine of Delhi Fluorspar Corp. declined for the third successive year. However, the 1944 deficit in production was partly offset by working the Eureka mine in Caldwell County. The company also purchased both finished fluorspar and milling ore from many local producers. Nevertheless, its shipments were 37 percent less than in 1943.

Shipments of fluorspar by L. Conyer, operating the Yates mine and a mill, both near Marion, were 42 percent less than in 1943. However, most of the ore milled in 1944 was from stock and purchased from local mines, chiefly the Hughett mine.

Crider Bros. Fluorspar Co. was organized in 1944; it operated the Blue mine near Mexico, Ky., and purchased local ore. Its mine was electrified, and a new washer was added to the mill in 1944.

The Corod Minerals Corp. completed its flotation mill near Marion but made no production of fluorspar concentrates.

In Livingston County most of the fluorspar output came from the C. R. Babb, Butler, Carr, Davis, Nancy Hanks, Old Silver, Guill, and Wright mines and from reworking the C. R. Babb, Klondike, and Nancy Hanks tailings.

Output at the C. R. Babb, Carr, and Wright mines of Roberts & Frazer was 11 percent less than in 1943. E. W. Frazer reworked the tailings at the C. R. Babb mine and recovered 536 tons of fluorspar.

Production at the Nancy Hanks mine, operated by W. V. Haynes, Jr., and Tinsley & Loyd, was slightly less than in 1943. In addition, Tinsley & Loyd reclaimed a substantial tonnage of sand spar from Nancy Hanks tailings.

Butler & Moodie (reclaiming fluorspar from Klondike tailings) and Butler, Moodie & Craighead (operating the Old Silver mine, which was opened in 1944) made substantial outputs during the year.

In the Central Kentucky district production of fluorspar declined to 1,867 tons (2,469 tons in 1943). Output from this district in 1944 came from the Faircloth mine in Woodford County near Wilmore, operated by Ralph E. Jones until August when it was sold to the Lone Oak Ore Co.; the Lone Oak mine near Harrodsburg in Mercer County, operated by the Lone Oak Ore Co. until September 10 when it was sold to J. B. Towles; the Gobel Dean mine near Talmage in Mercer County, operated by Mercer Minerals, Inc.; and the Twin Chimney mine near Mundys Landing in Mercer County, operated by the Lone Oak Ore Co. until March when it was sold to Ollie Neal who sold it on December 28 to Albert Brauer & Co. The last-named company is opening the Britain mine, also near Mundys Landing.

Nevada.—Shipments of fluorspar from Nevada in 1944 (7,293 short tons) were 16 percent smaller than in 1943 and 19 percent under the all-time record of 1941. Most of the 1944 total went to steel plants, but some was shipped to hydrofluoric-acid and cement plants and to nonferrous smelters.

The chief producing mine in Nevada in 1944 was the Baxter in Mineral County, operated by V. S. Baxter; its production was 8 percent less than in 1943. The other producing mine was the Daisy in Nye County, operated by J. Irving Crowell, Jr., and its production was 36 percent less than in 1943.

New Mexico.—Production of fluorspar in New Mexico continued its upward trend, uninterrupted for the eighth successive year. Production of finished fluorspar totaled 42,800 short tons, a gain of 15 percent over 1943. However, the 1944 production includes 2,300 tons of finished fluorspar recovered from treating some crude ore mined before 1944. Consequently, total mine production (expressed in terms of finished fluorspar) was 40,500 tons compared with 37,700 tons in 1943. The output came from Catron, Dona Ana, Grant, Hidalgo, Luna, and Valencia Counties.

Shipments from New Mexico totaled 42,973 tons, a gain of 16 percent over the former all-time high of 1943. The 1944 shipments comprised 22,557 tons of flotation concentrates and 20,416 tons of metallurgical-grade fluorspar.

The flotation mill of the General Chemical Co. at Deming was not operated during July and August; consequently, production was 17 percent less than in 1943. The mill feed comprised ore from the company Spar Group and Sadler mines in Luna County and the Osmer mine in Grant County and purchased ore from local mines. Virtually all the flotation concentrates produced were shipped to the hydrofluoric-acid plants of the company.

The flotation plant of the Zúñi Milling Co. at Los Lunas, which began operating in March 1943, was in 1944 again the largest producer of flotation concentrates in New Mexico. Production from both domestic and Mexican ore was 11 percent greater than in 1943. The mill feed comprised ore chiefly from the company mines in Valencia County, but some was purchased from local producers and from Mexico. However, the concentrates recovered from milling Mexican ore, as well as shipped, are not included in the statistics for New Mexico. The fluorspar deposits in the Zúñi Mountains have been discussed by Kutnewsky.⁸

The Grattan flotation mill at Deming was acquired on August 1 by Edgar J. Marston, who operated it the remainder of the year. In the plant a 5½- by 5-foot ball mill and new loading and unloading facilities were installed, the drying unit was enlarged and improved, and the flotation cells were improved. The mill feed comprised ore from the Fourth of July and Poor Boy mines in Greenlee County, Ariz., the Greenleaf and Sadler mines in Luna County, and the Mohawk mine in Grant County—all operated by Marston—and ore purchased from local mines, chiefly the Burro Chief in Grant County. The concentrates produced were shipped chiefly to hydrofluoric-acid plants.

The heavy-media-process plant at Gila, owned by the Metals Reserve Co. and operated for that company by the International Minerals & Chemical Co., was active throughout 1944 and produced 17,530 tons of fluxing-gravel fluorspar, which was placed in the Government stock pile at Gila. The plant feed comprised ore supplied chiefly by the Brown-Johnson Corporation from the Clum mine near Gila, by H. E. McCray from the Burro Chief mine near Tyrone, by

⁸ Kutnewsky, Fremont, Fluorspar Deposits in the Zúñi Mountains: *Mining Jour.* (Phoenix, Ariz.), vol. 28, No. 11, Oct. 30, 1944, pp. 4-5.

the Glenwood Mining & Milling Co. from the Huckleberry mine near Glenwood, and by D. F. McCabe from the Great Eagle mine near Red Rock. The plant has been described in the *Mining World*.⁹

The American Fluorspar Co. carried on development at the Blackbird prospect near Albuquerque in Bernalillo County and continued construction of a flotation mill.

Texas.—Production of finished fluorspar in Texas increased to 4,906 short tons (a new record) in 1944 from 1,253 tons in 1943. Shipments likewise jumped to 4,769 tons (960 tons in 1943). Production came chiefly from the Eagle Mountains mine in Hudspeth County near Van Horn, operated by the Western Fluorite Co., which completed a mill on January 15, 1945. The Eagle Mountains deposits have been described by Needham.¹⁰

The flotation mill of Alloy Metals near El Paso, Tex., began producing fluorspar concentrates in June. The mill feed comprised ore from mines in Arizona, New Mexico, and Texas and in Mexico. The mill was sold on October 19 to the Continental Milling Co., which operated it during the remainder of the year and milled ore from the Moll mine in Mexico. The flotation concentrates recovered from milling Mexican ore, as well as shipped, are not included in the statistics for Texas.

Utah.—An important event in Utah in 1944 was the beginning of operations in June at the new concentrating mill of the Tintic Standard Mining Co. near Milford. The mill feed came chiefly from its newly developed Cougar mine in Beaver County, but some purchased ore was also milled. The mill has been described briefly in the *Mining and Contracting Review*.¹¹ Mainly as a result of this operation, production of finished fluorspar in Utah increased to 3,490 short tons in 1944, an all-time high. Contributing also to the production were: Fred Staats, operating the Staats mine; the Western Fluorite Co., operating mines near Milford; the Manassa Mining & Milling Co., operating the J. B., Brown Thrush, and Manassa mines; and H. J. Holt, operating the Blue Bell mine—all in Beaver County; and George Spor & Sons, operating the "Spor" mine in Juab County. The Western Fluorite Co. and the Manassa Mining & Milling Co., both of which use the mill of the former, are considering addition of a flotation unit in the mill.

Washington.—There was no production of finished fluorspar in Washington in 1944. However, development was under way at the Mitchem mine in Ferry County near Keller by the Western Minerals Co., which virtually completed a heavy-media-process plant for treating the ore.

Wyoming.—The first commercial production of fluorspar in Wyoming was reported made in 1944; it amounted to 19 short tons of high-grade gravel and was mined from a pocket in one of the feldspar deposits of the Wyoming Feldspar Co. in Albany County near Federal. The pocket was exhausted.

FOREIGN TRADE

Imports.—Receipts of imported fluorspar into the United States established a new record of 92,499 short tons in 1944, a gain of 112

⁹ *Mining World*, International Minerals & Chemical Corp. Employs Coarse Concentration to Produce Metallurgical Grade Fluorspar: Vol. 6, No. 6, June 1944, pp. 26-29.

¹⁰ Needham, A. B., Eagle Mountain Fluorspar District: *Mining Jour.* (Phoenix, Ariz.), vol. 28, No. 6, Aug. 15, 1944, pp. 7-8.

¹¹ *Mining and Contracting Review*, Utah's New Fluorspar Project—Tintic Standard's Cougar Mill: Vol. 46, No. 8, Apr. 30, 1944, p. 5.

percent over 1943 and 22 percent more than in 1926, the previous record year. Some of the imported fluorspar received in 1944 was placed in bonded warehouses.

Fluorspar imported for consumption in the United States was 87,200 tons, a gain of 99 percent over 1943. The imports in 1944 comprised 5,562 tons containing more than 97 percent calcium fluoride and 81,638 tons of lower grade. They were valued¹² at \$1,680,104. The value assigned to the higher-grade foreign fluorspar averaged \$27.59 a ton in 1944 and that of the lower-grade \$18.70. The cost to consumers in the United States also includes duty, loading charges, insurance, consular fee, and freight to consuming plants. The duty on fluorspar containing not more than 97 percent calcium fluoride is \$5.625 a short ton and on fluorspar containing more than 97 percent calcium fluoride \$3.75 a ton.

Fluorspar imported for consumption in the United States, 1943-44, by countries¹ and customs districts

Country and customs district	Containing more than 97 percent calcium fluoride		Containing not more than 97 percent calcium fluoride		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1943						
Mexico:						
Buffalo.....			96	\$2,785	96	\$2,785
El Paso.....	773	\$10,161	6,112	62,604	6,885	72,855
Laredo.....	1,081	13,474	12,463	130,290	13,534	143,764
	1,854	23,635	18,661	195,769	20,515	219,404
Newfoundland: Buffalo.....			7,144	175,829	7,144	175,829
Spain: Philadelphia.....			15,540	224,432	15,540	224,432
Union of South Africa: New York.....			570	7,500	570	7,500
	1,854	23,635	41,915	603,530	43,769	627,165
1944						
Canada:						
Buffalo.....			65	1,768	65	1,768
Michigan.....			4	183	4	183
			69	1,951	69	1,951
Mexico:						
Buffalo.....			138	2,044	138	2,044
Chicago.....			46	1,462	46	1,462
El Paso.....	806	20,315	20,161	217,350	20,967	237,665
Laredo.....	2,404	47,522	34,089	678,388	36,493	725,910
Michigan.....			374	8,349	374	8,349
Philadelphia.....			306	4,659	306	4,659
	3,210	67,837	55,114	912,252	58,324	980,089
Newfoundland: Philadelphia.....	2,352	85,613	13,720	345,619	16,072	431,232
Spain: Philadelphia.....			9,177	222,080	9,177	222,080
Union of South Africa:						
Maine and New Hampshire.....			249	4,390	249	4,390
Maryland.....			852	11,225	852	11,225
New York.....			818	7,540	818	7,540
Philadelphia.....			1,638	21,551	1,638	21,551
			3,557	44,715	3,557	44,715
United Kingdom: New York.....			1	37	1	37
	5,562	153,450	81,638	1,526,654	87,200	1,680,104

¹ For historical table, see Minerals Yearbook, 1941, p. 1401.

¹² As defined in sec. 402 of the tariff act of 1930, "The value of imported merchandise * * * is the foreign value or the export value, whichever is higher—that is, the market value or the price at which the merchandise, at the time of exportation to the United States, is offered for sale in the principal markets of the country from which exported, including the cost of containers or coverings and all expenses (including any export tax) incident to placing the merchandise in condition ready for shipment to the United States."

In 1944, as in 1943, the bulk of the imported fluorspar was delivered to Government stock piles. However, 6,487 tons of the imports in 1943 and 1944 were milled in 1944 at flotation plants in the United States; and 4,494 tons of acid-grade, 229 tons of ceramic-grade, and 132 tons of metallurgical-grade fluorspar were recovered therefrom.

The following table, compiled from data furnished to the Bureau of Mines by importers and by domestic companies milling foreign fluorspar, shows the quantities of imported fluorspar delivered to consumers in the United States in 1943 and 1944, irrespective of year of importation into the United States; it differs from the preceding table, which shows the quantity and grade imported into the United States during 1943 and 1944. The quantities in the following table are based upon the actual outturn weights and include the finished fluorspar recovered from milling foreign ore rather than the ore milled.

Imported fluorspar delivered to consumers in the United States, 1943-44, by uses

Use	1943			1944		
	Short tons	Selling price at tide-water, including duty		Short tons	Selling price at tide-water, including duty	
		Total	Average		Total	Average
Steel.....	15,616	\$503,000	\$32.21	1,639	\$42,804	\$26.12
Hydrofluoric acid.....	140	3,535	25.25	5,907	208,067	35.22
Magnesium.....				224	6,419	28.66
Ferro-alloys.....				45	1,390	30.89
	15,756	506,535	32.15	7,815	258,680	33.10

¹ Estimated.

Exports.—Producers of fluorspar reported exports of 1,980 short tons of fluorspar valued at \$65,909 in 1944 compared with 9,044 tons valued at \$246,973 in 1943. The exports by producers in 1944 comprised 55 tons of fluxing gravel, 440 tons of ceramic ground, and 866 tons of flotation concentrates to Canada; 600 tons of flotation concentrates to Peru; and 8 tons of ceramic ground and 11 tons of flotation concentrates to Brazil.

Fluorspar reported by producers as exported from the United States, 1940-44

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1940.....	8,482	\$178,467	\$21.04	1943.....	9,044	\$246,973	\$27.31
1941.....	12,184	277,782	22.80	1944.....	1,980	65,909	33.29
1942.....	9,016	242,545	26.90				

WORLD PRODUCTION

The following table shows world production of fluorspar by countries from 1937 to 1944, insofar as statistics are available. Because of restriction on the publication of statistics by the governments of many countries, few figures are available since 1939.

World production of fluorspar, 1937-44, by countries, in metric tons¹

[Compiled by B. B. Waldbauer]

Country ¹	1937	1938	1939	1940	1941	1942	1943	1944
Argentina (shipments)	350	1,406	739	597	2,027	2,350	4,000	(?)
Australia:								
New South Wales	55						(?)	(?)
Queensland	1,410	2,479	20	888	708	311	(?)	(?)
Victoria		804			136	344	468	(?)
Canada	136	197	218	4,041	5,020	5,624	10,169	5,748
Chosen	11,000	34,207	(?)	(?)	(?)	(?)	(?)	(?)
France	51,430	51,920	(?)	48,004	41,901	27,447	24,846	12,825
Germany:								
Anhalt	13,662	10,462	(?)	(?)	(?)	(?)	(?)	(?)
Baden	13,637	21,350	(?)	(?)	(?)	(?)	(?)	(?)
Bavaria	62,455	59,919	(?)	(?)	(?)	(?)	(?)	(?)
Prussia	30,514	22,956	(?)	(?)	(?)	(?)	(?)	(?)
Saxony	8,074	12,063	(?)	(?)	(?)	(?)	(?)	(?)
Thuringia	16,117	22,405	(?)	(?)	(?)	(?)	(?)	(?)
India, British			20	(?)	(?)	(?)	(?)	(?)
Italy	13,385	12,186	(?)	(?)	(?)	(?)	(?)	(?)
Mexico (exports)	(?)	(?)	(?)	9,271	10,521	5,365	22,469	56,450
Newfoundland	8,479	8,944	11,227	14,697	11,581	32,660	66,170	58,290
Norway	1,692	1,676	2,367	(?)	(?)	(?)	(?)	(?)
Southern Rhodesia		150		(?)	(?)	(?)	(?)	(?)
South-West Africa		585	105	(?)	(?)	(?)	(?)	(?)
Spain	4,250	8,596	8,408	9,097	15,400	16,297	35,911	51,022
Switzerland						486	582	520
Tunisia	1,676	2,060	2,541	873	(?)	(?)	(?)	(?)
Union of South Africa	3,615	4,736	10,322	7,421	4,486	4,185	4,646	11,653
U. S. S. R.	70,000	(?)	(?)	(?)	(?)	(?)	(?)	(?)
United Kingdom	42,837	33,866	38,786	45,617	42,233	43,920	55,106	(?)
United States (shipments)	164,408	72,940	165,806	211,917	290,905	326,871	368,330	375,374
	519,000	456,000	(?)	(?)	(?)	(?)	(?)	(?)

¹ In addition to countries listed China produces fluorspar, but data of output are not available.² Data not available.³ Exports.⁴ Estimate.⁵ January to June, inclusive.⁶ Estimate included in total.

Canada.—According to the Dominion Bureau of Mines, production of fluorspar in Canada was 5,748 metric tons¹³ (5,730 tons from Ontario and 18 tons from Quebec) in 1944 compared with 10,169 tons in 1943. In Canada output falls far short of consumption, and the greater part of the deficiency is met by importations from Mexico, Newfoundland, and the United States. Imports in 1943 were 70,248 metric tons.

Great Britain.—Following the outbreak of war in 1939 Great Britain's greatly expanding war industries created an increased demand for fluorspar, chiefly by steel and hydrofluoric-acid manufacturers. Before the war the industry was in a chaotic and unprofitable condition, and most of the production, particularly in Derbyshire, was from dumps of fluorspar-gangue rejects of old lead mines, but such sources of supply were limited. Moreover, as the richest dumps had previously been worked the reserves had been much depleted, and the fluorspar remaining was of poor quality. Because the output from the waste dumps was insufficient to meet the increased wartime demand and to insure the maintenance of future supplies, the appeal of the Ministry of Supply to increase production and to develop underground deposits that were known to exist met with a most encouraging response, and as a consequence several mines were opened and equipment for beneficiating the material in waste dumps was installed. Moreover, in order that production and supply

¹³ 1 metric ton is equivalent to 1.10231 short tons.

problems might be dealt with in the most efficient manner, the British Fluorspar Producers' Association was formed. Production of fluorspar in the United Kingdom averaged 31,373 metric tons during the 10 years 1929-38; since that time it has increased almost progressively and reached 55,106 metric tons in 1943.

Mexico.—As a result of intensive development in Mexico in recent years, many deposits have been opened and that country, formerly a small producer, has now become an important one. Reserves are said to be large. Exports were 56,450 metric tons in 1944 (22,469 tons in 1943). The bulk of the exports went to the United States, but some went to Canada. During 1944 the Continental Milling Co. acquired the flotation mill of Alloy Metals near El Paso, Tex., for milling ore from the Moll mine.

Newfoundland.—Before 1942 the St. Lawrence Corp. of Newfoundland, Ltd., was the only producer of fluorspar in Newfoundland, and between 1933 (when the first shipments were made) and 1941 output ranged from 1,451 to 14,697 metric tons. During 1942 production was inaugurated at the newly opened mine of Newfoundland Fluorspar, Ltd., a subsidiary of the Aluminum Co. of Canada, Ltd.; as a consequence, output of fluorspar in Newfoundland skyrocketed to 66,170 tons in 1943 but declined to 58,290 tons in 1944. Exports were only 42,016 metric tons in 1944. The St. Lawrence Corp. of Newfoundland, Ltd., has a gravity-concentration mill and a flotation mill for treating the ore from its mines; the finished fluorspar is shipped to Nova Scotia and the United States. Newfoundland Fluorspar, Ltd., ships its crushed fluorspar to Arvida, Quebec, where it is treated by flotation; the resultant acid-grade concentrate is used by the Aluminum Co. of Canada, Ltd.

Fluorspar reserves of Newfoundland are reported to be large. According to Van Alstine:¹⁴

Shafts have been sunk and underground work has been done on 7 veins, but nearly all of the present production is from 4 veins. Some veins are more than a mile long and contain numerous workable lenses. Mining has progressed to a maximum depth of 350 feet, and no vein has been mined to the lower limit of workable fluorspar. Veins are of two types: High-grade containing over 95 percent CaF_2 and averaging about 5 feet thick, and lower grade containing about 75 percent CaF_2 and averaging between 15 and 20 feet thick. No marked changes in the mineralogy or grade of the fluorspar veins have been observed with increased depth of mining to a level of 350 feet.

Spain.—Chiefly as a result of demand by Germany and the United States, production of fluorspar in Spain, formerly a relatively small producer, has increased phenomenally since 1941. During the 5 years 1936-40 production averaged 7,509 metric tons annually; it increased to 15,400 and 16,297 tons, respectively, in 1941 and 1942 but jumped to 35,911 and 51,022 tons, respectively, in 1943 and 1944. The bulk of the output comes from Oviedo Province and is produced at the Berbes, Caravia, Collada, Dosal, and Pilar mines. A flotation mill was reported to have been installed at Pinzales, Gijón Province, to treat ore from the Collada mine. Other producing mines are the Papiol in Barcelona Province, the Osor in Gerona Province, and the Fuenteovejuna in Córdoba Province. Control of the Papiol, Osor, Collada, and Caravia mines was obtained by German companies in 1943.

¹⁴ Van Alstine, R. E., Fluorspar Deposits of St. Lawrence, Newfoundland: Econ. Geol., vol. 39, No. March-April 1944, pp. 109-132.

CRYOLITE

Imports of cryolite were 15,680 long tons valued at \$1,155,787 in 1944 compared with 46,400 tons valued at \$3,117,888 in 1943. Except for a few hundred pounds from Canada in 1944, the cryolite imported in both years came from Greenland.

Cryolite occurs in commercial quantity and is mined at only one place—Ivigutut, Greenland. Gibbs¹⁵ has described the mine at Ivigutut, the grades of ore produced, methods of processing and purification, and various uses of cryolite.

Artificial cryolite was manufactured in the United States in 1944 by the Aluminum Ore Co. at East St. Louis, Ill. Production was 78 percent less than in 1943. As a measure of insurance for the war program, plants for the manufacture of artificial cryolite were completed in 1943 at Bauxite, Ark., by the Aluminum Ore Co., and at Cornwells Heights, Pa., by the Pennsylvania Salt Manufacturing Co., but neither has been operated.

The chief use of cryolite is in the reduction of aluminum; comparatively small amounts are used in glass, enamels, abrasives, and insecticides.

A sizeable proportion of the cryolite used in the United States is made from fluorspar. According to Frary:¹⁶

The fluorspar is treated with sulfuric acid to produce hydrofluoric acid, and this is neutralized with the proper amounts of soda ash and aluminum hydrate to produce the cryolite, which is a double fluoride of sodium and aluminum (Na_3AlF_6). The artificial cryolite is quite satisfactory and, in fact, considerably lower in objectionable impurities than the natural cryolite usually used. There would be no serious difficulty in getting along with the artificial product if the supply of natural cryolite from Greenland is shut off.

Because of a large reserve of cryolite in the United States and cut-backs in aluminum production, all restrictions on its use were removed on October 6, 1944, by the War Production Board through revocation of Preference Order M-198, which had been issued on September 18, 1942.

¹⁵ Gibbs, A. E. (technical director, Pennsylvania Salt Manufacturing Co.), *Cryolite as a Chemical Raw Material*: Chem. Ind., vol. 38, May 1936, pp. 471-476.

¹⁶ Frary, F. C., *Cryolite from Fluorspar*: Steel, vol. 108, No. 26, June 30, 1941, p. 4.

FELDSPAR

By ROBERT W. METCALF AND A. B. CADE ¹

SUMMARY OUTLINE

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SUMMARY

Stimulated by the active market for glass and glass products and a heavy demand from the armed forces for chinaware, dinnerware, and sanitary pottery and despite labor shortages the outputs of both crude and ground feldspar in 1944 increased compared with 1943. In tonnage, each was only 3 percent under the record year 1941. Total realization for crude spar sold in 1944 was the highest on record, 10 percent above 1943, the previous high. The total value of ground feldspar in 1944 also established a new record and was 2 percent over 1941, the former peak year in realization for ground spar. Production of crude feldspar in North Carolina in 1944, aided to some extent by the active hunt for mica, surpassed by 10 percent its largest previous output (in 1943).

Salient statistics of the feldspar industry in the United States, 1942-44

	1942	1943	1944	Percent of change in 1944
Crude feldspar:				
Domestic sales:				
Long tons.....	316,166	308,180	327,408	+6.2
Value.....	\$1,546,702	\$1,646,277	\$1,813,937	+10.2
Average per long ton.....	\$4.89	\$5.34	\$5.54	+3.7
Imports:				
Long tons.....	9,525	10,758	11,686	+8.6
Value.....	\$69,798	\$83,073	\$95,956	+15.5
Average per long ton.....	\$7.33	\$7.72	\$8.21	+6.3
Ground feldspar:				
Sales by merchant mills:				
Short tons.....	327,796	335,810	343,201	+2.2
Value.....	\$3,524,960	\$3,591,960	\$3,863,036	+7.5
Average per short ton.....	\$10.75	\$10.70	\$11.26	+5.2
Imports:				
Short tons.....		41	10	-75.6
Value.....		\$417	\$203	-51.3
Average per short ton.....		\$10.17	\$20.30	+99.6

¹ Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

The increased activity in the feldspar market in 1944 compares favorably with a 7-percent over-all increase in the value of glass products.² Glass container production was 7 percent higher than in 1943 and shipments about 1½ percent greater, with an accompanying jump of 15 percent in inventories at the end of 1944. Plate-glass production in 1944, although considerably below prewar levels, increased 36 percent compared with 1943. Of particular interest is the demand created by the commissioning of many ships and the supplying and outfitting of the many new naval and military establishments, which caused a large gain in, and to a more limited extent, a continuing market for chinaware, semivitrified dinnerware, and sanitary and electrical porcelain.

POSTWAR OUTLOOK

The prosperity of the feldspar industry is intimately associated with fluctuations in glass, pottery, and enamel manufacture because over 95 percent of the ground feldspar marketed in the United States is generally consumed by the ceramic industries and over half in the manufacture of glass alone. Any factor, therefore, which influences these industries inevitably in turn affects the production of feldspar.

Two major movements, it is believed, will affect profoundly the fortunes of the feldspar operators: First, construction activity—the prevalence of new building, particularly residential construction, and, to a considerable extent, also the accumulated need for extensive modernization of existing housing, especially kitchen and bathroom renovation; and second, the increasing trend toward the use of more glass in all realms of domestic and industrial economy.

Increased residential and commercial building will bring about a greatly expanded market for floor and wall tile and for porcelain enameled products as the current output of both of these industries has been curtailed on account of war priorities. In the manufacture of these products, 10 to 55 percent and 25 to 50 percent, respectively, of the batch ordinarily consist of feldspar, and detailed and extensive plans for expansion in the postwar markets have been projected. Demand for electrical and sanitary porcelain, as well as whiteware and hotel china, undoubtedly will improve when building activity gets under way.

Structural glass—glass brick, hollow tile, glass walls, partitions, and similar materials—has been the subject of much investigation and will share in postwar construction plans. In this connection, the so-called “solar” heating, with the greater glassed area and thicker, larger individual glass pieces, is a new and interesting development. Coal and other chutes of abrasion- and acid-resistant glass have proved feasible in certain instances. Glass containers, a heavy consumer of feldspar, have excellent prospects of retaining some part, at least, of the business taken over on account of shortages of tin and steel. Because of shortages and tight supplies of materials such as plastics steel, nickel, copper, aluminum, zinc, and rubber in recent war years glass has been used as a replacement in many industrial applications. Also of considerable interest to the marketer of feldspar is the expanding development of glass fiber, glass wool, and the more recently developed combinations of glass fibers with other substances such as asbestos and plastics.

² Glass Industry, vol. 26, No. 3, March 1945, p. 134.

In view of probable expansion in the feldspar market and exhaustion of many of the more readily available deposits of the better grades of spar, the beneficiation of low-grade feldspars or intimately mixed material has attracted the imagination of many of the industry's key men. Now for several years a certain amount of run-of-mine spar has been processed by fine grinding and removal of impurities either by screening or air separation, followed by magnetic separation. The application of flotation methods to the refining of feldspar, however, is a new and promising development. A plant recently has been placed in operation in North Carolina to treat alaskite rock, a quartz-feldspar pegmatite occurring in abundance in the Spruce Pine area in that State. The widespread distribution of feldspar in rock of a type similar to alaskite, such as granite, points to an almost unlimited reserve, which with the development and perfection of flotation separation would become presently available. The more general application of flotation presages also a radical change in mining methods—the ultimate substitution, in large part, of large-scale quarrying for the hand operation of many comparatively small, isolated pits.

DOMESTIC PRODUCTION

Larger outputs in response to a greatly augmented demand, particularly from glass manufacturers and potteries, were hampered by labor shortages, due in a large degree to competitive war industries and to selective service calls for available manpower; increased costs; and tightness of supply of new equipment and replacements.

Following the usual practice in the industry, crude feldspar is reported in long tons of 2,240 pounds and ground feldspar in short (net) tons of 2,000 pounds.

Crude feldspar.—The active demands for crude feldspar in 1944 resulted in an increase of 6 percent in quantity compared with 1943. The tonnage sold or used was only 3 percent less than in the record year 1941. The value of the crude spar sold in 1944 reached a new high and was 10 percent above that reported in the highest previous year (1943).

Crude feldspar sold or used by producers in the United States, 1940-44

[Value at mine or nearest shipping point]

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1940.....	290,763	\$1,271,995	\$4.37	1943.....	308,180	\$1,646,277	\$5.34
1941.....	338,860	1,519,456	4.48	1944.....	327,408	1,813,937	5.54
1942.....	316,166	1,546,702	4.89				

No clear picture of increase (or decrease) of production by producing sections or regional areas emerges from a study of the changes of output in 1944 in individual States or combination of States, except perhaps for the North Carolina-Virginia producing area, where production increased considerably. In New England and in the West, some States were higher and some lower than in 1943.

Feldspar was mined in the same 13 States in 1944 as in 1943 and 1942. In 1944 sales in North Carolina, the largest producer, totaled

122,857 long tons valued at \$778,007, a new record in both quantity and value—10 and 19 percent, respectively, larger in tonnage and value than in 1943. Production in Maine and Virginia increased 19 and 17 percent, respectively. Tonnages mined in New Hampshire and Arizona also were substantially higher than in 1943, although actual data or approximate percentages of change may not be shown. Output in Wyoming was the largest ever produced in that State. On the other hand, California, Colorado, Connecticut, New York, and South Dakota reported small to sizable declines in output.

Crude feldspar sold or used by producers in the United States, 1942-44, by States

[Value at mine or nearest shipping point]

State	1942		1943		1944	
	Long tons	Value	Long tons	Value	Long tons	Value
Arizona.....	(1)	(1)	(1)	(1)	(1)	(1)
California.....	5,090	\$23,261	(1)	(1)	(1)	(1)
Colorado.....	33,610	135,569	20,659	\$98,691	15,787	\$81,967
Connecticut.....	12,807	92,076	11,618	76,463	11,390	75,394
Maine.....	8,835	53,143	6,748	41,652	8,011	47,882
New Hampshire.....	46,544	241,990	(1)	(1)	(1)	(1)
New York.....	(1)	(1)	(1)	(1)	(1)	(1)
North Carolina.....	93,644	533,448	112,144	656,182	122,857	778,007
Pennsylvania.....	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota.....	64,842	225,410	70,913	242,643	64,806	228,188
Texas.....	(1)	(1)	(1)	(1)	(1)	(1)
Virginia.....	24,298	140,304	20,550	122,967	24,010	147,166
Wyoming.....	13,953	50,730	(1)	(1)	22,415	81,770
Undistributed ¹	12,543	50,771	65,548	317,689	58,132	313,613
	316,166	1,546,702	308,180	1,646,277	327,406	1,813,937

¹ Included under "Undistributed."

² Includes States indicated by "(1)."

Quotations on crude feldspar are not reported in trade publications dealing with mineral industries. However, average realizations have been computed from the production questionnaires returned to the Bureau of Mines each year by the operators. According to these data, the average sales realization per long ton for crude feldspar in 1944 increased 4 percent to \$5.54 compared with \$5.34 in 1943. The 1944 figure was the highest reported since 1931. Average realizations for most States were higher in 1944 than in 1943. Small decreases appear in four States only—California, Maine, New Hampshire, and South Dakota. Averages per ton for certain States in 1943 and 1944 (1943 in parentheses) follow: North Carolina \$6.33 (\$5.85); Virginia, \$6.13 (\$5.98); Connecticut, \$6.62 (\$6.58); Maine, \$5.98 (\$6.17); Colorado \$5.19 (\$4.29); South Dakota, \$4.45 (\$4.83).

Ground feldspar.—Sales of ground feldspar by merchant mills in 1944 increased 2 percent in quantity and 8 percent in value compared with 1943 and were only 3 percent less in quantity than in the record year 1941. Total value of sales in 1944 established a new high—\$3,863,026 or 2 percent greater than in 1941, the former peak year. North Carolina and Tennessee plants combined furnished 32 percent of the total ground feldspar sold compared with 30 percent in 1943 and 26 percent in 1942. In most States relative production changed very little in 1944 compared with 1943. Sales of feldspar of Canadian origin ground in merchant mills in the United States in 1944 totaled only 2 percent of the total merchant sales, as in 1943, compared with

3 percent in 1942 and 6 percent in 1937. In addition to the tonnage just indicated, relatively small tonnages of Canadian origin are ground by consumers, principally pottery and cleanser manufacturers, who import this product direct and whose data are not included in these compilations.

Ground feldspar sold by merchant mills ¹ in the United States, 1940-44

Year	Active mills	Domestic			Canadian			Total	
		Short tons	Value		Short tons	Value		Short tons	Value
			Total	Average		Total	Average		
1940.....	29	277,612	\$2,912,470	\$10.49	8,101	\$153,012	\$18.89	285,713	\$3,065,482
1941.....	29	347,092	3,646,404	10.51	7,325	136,199	18.59	354,417	3,782,603
1942.....	29	318,209	3,339,462	10.49	9,577	185,507	19.37	327,786	3,524,969
1943.....	27	329,354	3,465,885	10.52	6,456	126,075	19.53	335,810	3,591,960
1944.....	28	335,491	3,714,039	11.07	7,710	148,997	19.33	343,201	3,863,036

¹ Excludes potters or others who grind for consumption in their own plants.

South Dakota in 1944, as in 1942 and 1943, ranked first in production of ground feldspar, followed by Tennessee, North Carolina, Colorado, and New Hampshire. Of those States for which figures may be shown, New Jersey-Connecticut in 1944 increased 6 percent and North Carolina-Tennessee increased 10 percent compared with 1943. Arizona and Colorado both showed considerable gain in production in 1944, but shipments from South Dakota and Virginia declined.

Ground feldspar sold by merchant mills ¹ in the United States, 1942-44, by States

State	1942			1943			1944		
	Active mills	Short tons	Value	Active mills	Short tons	Value	Active mills	Short tons	Value
Arizona.....	1	(²)	(²)	1	(²)	(²)	1	(²)	(²)
California.....	3	5,578	\$72,924	2	(²)	(²)	3	1,188	\$17,688
Colorado.....	3	51,684	349,065	3	39,326	\$271,854	3	45,365	318,906
Connecticut.....	1	(²)	(²)	1	(²)	(²)	1	(²)	(²)
Illinois.....	1	(²)	(²)	1	(²)	(²)	1	(²)	(²)
Maine.....	3	14,052	206,633	2	(²)	(²)	2	11,184	178,049
New Hampshire.....	2	(²)	(²)	2	(²)	(²)	2	(²)	(²)
New Jersey.....	3	22,649	402,479	3	20,780	365,483	3	22,079	409,875
New York.....	4	(²)	(²)	3	(²)	(²)	3	(²)	(²)
North Carolina.....	2	86,240	1,037,998	3	100,157	1,181,000	3	110,251	1,326,861
Tennessee.....	2			2			2		
South Dakota.....	2	68,025	483,075	2	(²)	(²)	2	(²)	(²)
Virginia.....	2	(²)	(²)	2	(²)	(²)	2	(²)	(²)
Undistributed.....		79,558	972,795		175,547	1,775,023		153,134	1,611,867
	29	327,786	3,524,969	27	335,810	3,591,960	28	343,201	3,863,036

¹ Excludes potters or others who grind for consumption in their own plants.

² Included under "Undistributed."

³ Connecticut included with New Jersey.

⁴ Includes items indicated by "(²)."

The average realization per short ton for ground feldspar in 1944 rose to \$11.26, an increase of 5 percent compared with 1943, and was the highest realization since 1938 (\$11.50). In all States except Arizona, California, and Illinois, the average value of ground spar increased, the percentages of change varying in most States from less

than 1 to about 5. Realization in Arizona and California in 1944 was less than in 1943, but in Illinois it remained unchanged. Average values per short ton for individual States in 1944 ranged from \$7.03 to \$18.56. Average realizations for selected States in 1944 follow: Colorado, \$7.03; South Dakota, \$7.96; North Carolina-Tennessee, \$12.03; New Hampshire, \$11.26; Maine, \$15.92; and New Jersey-Connecticut, \$18.56.

According to E&MJ Metal and Mineral Markets, quoted prices of ground feldspar in 1944 remained unchanged compared with those reported in the last two or three years. Potash and soda feldspars, f. o. b. North Carolina, 200-mesh, white, in bulk, were quoted at \$17 and \$19 per short ton, respectively. Maine potash and soda feldspars carried similar quotations. Granular glass feldspar, f. o. b. North Carolina, 20-mesh, white, in bulk, was quoted at \$12.50 per ton, and semigranular glass spar at \$11.75 per ton. Quotations on Virginia feldspar, as listed by the same source, were: No. 1, 230-mesh \$18; 200-mesh, \$17; glassmakers' spar No. 18, \$12.50; and No. 17, \$11.75. Ground feldspar for enamelers' use, ranged from \$14 to \$16 per ton, f. o. b. on either a Spruce Pine (N. C.), or Keene (N. H.) basis.

CONSUMPTION AND USES

Crude feldspar.—Most crude feldspar is sold to merchant mills, which may obtain their requirements from several mines or localities. The raw spar is stock-piled, sorted according to grade and source, blended and ground to specified fineness, perhaps run through magnetic separators to remove excess iron, and sold to ultimate consumers. However, a few pottery and enamel manufacturers purchase part or all of their feldspar crude and grind it in their own mills. Certain makers of soap, cleansers, and sweeping compounds also mine or purchase crude feldspar, largely from New England, Virginia, and North Carolina, and after grinding or otherwise processing it utilize the abrasive properties of the spar in their products. Manufacturers of artificial teeth annually consume a small tonnage of very carefully selected crude material, which must be free of all grit and is sold at a considerable premium over the No. 1 grade commercial feldspar.

Ground feldspar.—Sales of ground feldspar to ceramic industries in 1944 were 98 percent of total shipments; as a rule they constitute annually more than 95 percent of such shipments. Most of the ground spar consumed is used by glass and pottery makers. Shipments to the glass trade in 1944 totaled 220,734 short tons, a new high for this industry and about 3 percent above 1943 sales, although representing about the same proportion of total sales as in 1943 (64 percent). Sales to potteries increased to 31 percent of the ground spar sold. Percentages of total value of sales in 1944 for these two uses were: Glass 51 percent and pottery 43 percent. Sales of enamel remained at low ebb, although slightly above 1943. Sales of ground spar in 1944 for use in soaps, cleansers, and abrasives were somewhat less than in 1943. The remainder of the ground feldspar sold by merchant mills in 1944 (much less than 1 percent of total shipments) was utilized for miscellaneous ceramic purposes other than glass, pottery, or enamel and in various other applications, largely not specified.

Ground feldspar sold by merchant mills in the United States, 1942-44, by uses

Use	1942		1943		1944	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Ceramic:						
Glass.....	195,601	59.7	214,668	63.9	220,734	64.3
Pottery.....	106,081	32.4	97,887	29.2	106,341	31.0
Enamel.....	13,899	4.2	7,147	2.1	8,464	2.5
Other ceramic uses.....	6,459	2.0	1,261	.4	8,849	.2
Soaps and abrasives.....	4,396	1.3	9,481	2.8	6,424	1.9
Other uses.....	1,350	.4	5,366	1.6	389	.1
	327,786	100.0	335,810	100.0	343,201	100.0

Distribution of shipments of ground feldspar from merchant mills into consuming States in 1944 showed little change, except for shipments into Pennsylvania, which increased 32 percent, and into California, Mississippi, New York, and Texas, which showed increases of less magnitude. Shipments to most other important consuming States in 1944 were slightly lower than in 1943. Shipments in 1944 to Illinois and Pennsylvania each comprised 14 percent of the total shipments; to West Virginia, 13 percent; to Ohio and Indiana, 12 percent each; to New Jersey, 11 percent; and to New York, 6 percent. Sizable shipments also were made to Maryland, Oklahoma, Tennessee, Texas, and Wisconsin.

Ground feldspar shipped from merchant mills in the United States, 1940-44, by destinations, in short tons

Destination	1940	1941	1942	1943	1944
California.....	7,897	10,444	12,224	8,669	9,788
Illinois.....	32,811	44,573	50,450	49,302	49,434
Indiana.....	28,634	39,620	38,998	40,873	40,057
Maryland.....	(1)	(1)	8,745	9,028	7,593
Massachusetts.....	(1)	(1)	3,630	3,855	3,508
New Jersey.....	42,381	44,249	43,029	40,259	38,158
New York.....	13,236	18,326	18,363	18,024	21,886
Ohio.....	50,835	52,270	43,950	42,536	41,208
Oklahoma.....	(1)	(1)	8,002	(1)	(1)
Pennsylvania.....	47,431	54,534	40,013	36,190	47,803
Tennessee.....	5,911	9,697	3,507	2,677	4,983
West Virginia.....	21,889	29,916	35,161	48,940	45,658
Wisconsin.....	6,967	10,517	7,837	8,718	7,993
Other destinations ¹	27,721	40,271	13,877	26,739	25,132
	285,713	354,417	327,786	335,810	343,201

¹ Included under "Other destinations"; separate figure for State not available.

² Includes Arkansas, Colorado, Connecticut, District of Columbia, Hawaii, Kentucky, Louisiana, Maryland (1940-41), Massachusetts (1940-41), Michigan, Minnesota, Mississippi, Missouri, Oklahoma (1940-41, 1943-44), Puerto Rico, South Carolina, and Texas, and other States (shipments to which cannot be segregated); also small shipments to Canada, England, and Mexico.

TECHNOLOGIC DEVELOPMENTS

Of particular interest in the development of glass and its products—and for this reason to the feldspar industry whose chief market is the glass trade—are the increase in container manufacture, the greater demand for various glass-fiber goods, and the more widespread use of heat-resisting kitchenware and tableware. In this connection may be mentioned particularly the use of glass fibers combined with other

substances to create new products with improved characteristics. A textile of glass and asbestos, for instance, that combines high strength with light weight and is exceedingly resistant to abrasion, high temperatures, and corrosive fumes, has been developed by Owens-Corning Fiberglas Corp.³ Another new application is the mixture of glass fiber with plastics,⁴ which opens a whole field of new products of unexplored characteristics and latent usefulness.

Laboratory and plant-trial studies of the use of soda feldspar as a complete replacement of the usual potash feldspar in whiteware bodies were reported by Blackburn and Loomis.⁵ Difficulty of maintaining uniformity of the feldspar constituent in the mixtures used in the manufacture of pyrometric cones was described in a study of their constitution.⁶

The use of glass of controlled solubility has been suggested as a fertilizer.⁷ All of the elements necessary for plant growth except nitrogen, water, and organic material, may be included in the glass structure. Experiments were carried out on fused mixtures of rock phosphates, potassium carbonates, and silica. Feldspar, however, might be used as a source of potash, and other rocks as sources of various mineral raw materials, on the theory that when crystalline substances are heated sufficiently to form a glass, their lattice structure is broken down and the constituent mineral matter becomes more readily assimilable as plant food.

The manufacture of refractory articles, using a powdered nonplastic material (not an oxide) such as SiC , B_4C , BN , feldspar, singly or as mixtures, is described in a recent British patent.⁸ The material is plasticized by mixing with a metal stearate or other fatty or aromatic acid salt in a suspension of a volatile organic liquid, such as turpentine, and is dried and granulated through 40-mesh screen. The product may be shaped by pressing, extrusion, throwing on a potters' wheel, or other suitable means. Finely divided feldspar has been used as the abrasive element in the preparation of a liquid abrasive polishing composition intended for smoothing and brightening lacquered and enameled surfaces.⁹

OTHER DEVELOPMENTS

After preliminary tests, including pilot-plant operation at Erwin, Tenn., which had proved it possible to recover a clean feldspar low in free silica from alaskite rock, a quartz-feldspar pegmatite abundant in that section of the State, the Consolidated Feldspar Corp. has erected a full-scale flotation plant at Kona, N. C., to treat this comparatively low-grade material. The mill, planned eventually to have a capacity of 750 tons, also will recover quartz and mica as byproducts.¹⁰ Cold River Minerals, Inc., Bellows Falls, Vt., leased the mine and mill of

³ American Ceramic Society Journal, Glass-Asbestos Textile: Vol. 23, No. 10, Oct. 15, 1944, p. 167.

⁴ Preston, Frank W., Significance of New Data on Combinations of Plastic and Glass Fibers: *Glass Ind.*, vol. 23, No. 6, June 1944, pp. 266-284.

⁵ Blackburn, A. R., and Loomis, G. A., Use of Soda Feldspar in Whiteware Bodies: *Am. Ceram. Soc. Abs. and Bull.*, vol. 24, No. 4, Mar. 15, 1945, p. 106 (Bulletin Section), Abstract.

⁶ McCaughey, Wm. J. and Neff, John M., Notes on the Constitution of Pyrometric Cones: *Ceram. Abs. and Bull.* (Bulletin Section), vol. 23, No. 10, Oct. 15, 1944, pp. 373-375.

⁷ Badger, A. E., and Bray, R. H., Soluble Glass May Offer Fertilizer Possibilities: *Chem. and Met. Eng.*, vol. 52, No. 4, April 1945, pp. 112-113.

⁸ Thermal Syndicate and G. N. Peel, Manufacture of Refractory Articles: *British Pat.* 565,866, Mar. 11, 1943; *British Abs.*, BI, February 1945, p. 67.

⁹ Oakes, Byron, J., and Murray, Dean K. (assigned to Minnesota Mining & Manufacturing Co.), Liquid Polishing Compositions Suitable for Use on Lacquered and Enameled Surfaces: *U. S. Patent* 2,356,762, Aug. 29, 1944; *Chem. Abs.*, vol. 39, No. 1, Jan. 10, 1945, p. 172.

¹⁰ *Pit and Quarry*, vol. 27, No. 9 March 1945, p. 74.

the General Minerals Corp. Work started in July 1944 and continued until the early part of February 1945, when the mill was destroyed by fire. Plans are being considered to rebuild. The Atlas Feldspar Corp., Broadalbin, N. Y., has been liquidated. A new feldspar grinder in California is Robinson & Stephens, at La Verne.

NEPHELINE SYENITE

The production and use of nepheline syenite, particularly in the manufacture of glass, continued to provide lively competition for feldspar, although output decreased slightly. A broad program of research has widened the practicable applications of nepheline to other branches of ceramics, such as pottery, sanitary and electrical porcelain, floor and wall tile, and other related uses. In the field of raw leadless glazes for whiteware, it is also claimed that nepheline syenite promotes early vitrification and that its use is preferable to that of feldspar.¹¹ The principal market, however, remains the manufacture of glass and glass products.

Nepheline syenite is not produced commercially in the United States. Except for Russia, the volume of whose output is not known, Canada is the only known producer. The American Nepheline Corp. has operated a quarry at Blue Mountain, Methuen Township, Peterborough County, Ontario, since 1936. A processing mill was erected at Lakefield, Ont., in that year. Most of the quarry's production, however, now is shipped to the larger, more recently erected mill at Rochester, N. Y., which supplies both glass and pottery grades as well as small amounts for the enameling trade. After preliminary flotation tests by the Canadian Bureau of Mines, investigation on a semi-commercial scale was undertaken during 1943 at the Rochester plant. A combination of jigging and flotation proved effective in eliminating the major part of the most objectionable impurity, corundum, and the entire Rochester mill was converted to flotation the following year (1944).

Port Coldwell Mines & Metals, Ltd., which in 1943 acquired the nepheline property of the former Port Coldwell Mining Syndicate at Port Coldwell, on the northern shore of Lake Superior, obtained control of nepheline syenite deposits near Bancroft, Hastings County, Ontario. This firm has extensive plans for erecting a new 100-ton mill in this area. The Port Coldwell deposits apparently remain unexploited.

Known occurrences of nepheline syenite in Canada, other than those mentioned above, are in the French River area, Georgian Bay district, Ontario; in the Montreal and Labelle-Annonciation areas in Quebec; and in the Ice River district, near Field, in British Columbia.¹² A deposit of nepheline syenite recently has been reported near Wausau, Wis.¹³

As already indicated, the larger part of the Canadian output is shipped to Rochester, N. Y., to be ground and marketed in the United States. No receipts of Canadian ground material were reported in 1944. Imports of crude nepheline syenite in 1944 decreased 9 percent

¹¹ Swift, Howard R., and Harmon, C. G., Raw Leadless Whiteware Glazes: Jour. Am. Ceram. Soc., vol. 28, No. 2, Feb. 1, 1945, pp. 48-52.

¹² Canada, Dominion Bureau of Statistics, The Feldspar and Quartz Mining Industry in Canada 1943: Ottawa, Canada, 1944, p. 3.

¹³ Engineering and Mining Journal, vol. 146, No. 4, April 1945, p. 124.

in quantity and value compared with the peak year 1943, although they were substantially higher than in 1942. All imports of crude and ground nepheline into this country have originated in Canada.

Nepheline syenite imported for consumption in the United States, 1940-44

Year	Crude		Ground		Year	Crude		Ground	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1940.....	27, 888	\$87, 162	6	\$25	1943.....	43, 105	\$150, 225	737	\$7, 690
1941.....	35, 799	112, 101	1, 359	13, 695	1944.....	39, 043	136, 664	-----	-----
1942.....	36, 990	120, 688	4	44					

Quotations on crude nepheline syenite do not appear in the trade press. However, average values per short ton (estimated foreign market value) of imports of this product into the United States in recent years were as follows: 1940 and 1941, \$3.13; 1942, \$3.35; 1943, \$3.49, and 1944, \$3.50. Canadian Chemistry and Process Industries reported quotations during 1944 on prepared (ground) nepheline syenite at the same levels as in 1942 and 1943: Grade A, 20-mesh, bulk, in carlots, \$11.75 per ton; grade A, 200-mesh, bulk, in carlots, \$16.50 per ton; and grade B, dust, bulk, in carlots, \$10 per ton, f. o. b. Lakefield, Ontario. However, most of the 200-mesh material now is ground at Rochester, N. Y.

APLITE

Closely following increased output and shipments of glass products, particularly glass containers, shipments of ground "aplite" in 1944 rose 4 percent in tonnage and 7 percent in value to a new high for this product. By far the major part of the output is sold to glass manufacturers. Figures, however, may not be published, as to do so would reveal operations of individual companies.

Two firms are engaged in the processing of aplite: Dominion Minerals, Inc., Washington, D. C. (the first company to begin operations), and Carolina Mineral Co., Erwin, Tenn., an affiliate of the Consolidated Feldspar Corp., Trenton, N. J. Both companies operate grinding mills near Piney River, Va.

IMPORTS

Feldspar.—Imports of crude feldspar into the United States in 1944 were 9 percent greater in quantity and 16 percent greater in value than in 1943. Average value per long ton of imported crude spar has been steadily rising since 1940, reaching \$8.21 in 1944 compared with \$7.72 in 1943 and \$7.33 in 1942. All imports of both crude and ground material originated in Canada.

Feldspar imported for consumption in the United States, 1940-44

Year	Crude		Ground		Year	Crude		Ground	
	Long tons	Value	Short tons	Value		Long tons	Value	Short tons	Value
1940.....	12, 522	\$80, 274	-----	-----	1943.....	10, 758	\$83, 073	41	\$417
1941.....	11, 253	73, 236	-----	-----	1944.....	11, 686	96, 956	10	203
1942.....	9, 525	69, 798	-----	-----					

Cornwall stone.—Receipts of unmanufactured Cornwall stone in 1944 increased 18 percent in quantity and 14 percent in value compared with 1943. Average value (foreign market value) in 1944 dropped to \$13.81 from \$14.26 per long ton in 1943, or almost to the 1942 level (\$13.80). The United Kingdom remains the sole source of supply.

Cornwall stone imported for consumption in the United States, 1940-44

Year	Unmanufactured		Ground		Year	Unmanufactured		Ground	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1940.....	2,261	\$20,812	228	\$2,758	1943.....	392	\$5,591	20	\$442
1941.....	2,736	31,138	182	2,658	1944.....	463	6,394	10	225
1942.....	74	1,021	5	92					

WORLD PRODUCTION

In addition to the United States, sizable production of feldspar has been reported in normal years from Canada, Norway, Sweden, Finland, Germany (Bavaria), Czechoslovakia, Italy, and China.

World production of feldspar, 1937-44, by countries, in metric tons¹

[Compiled by B. B. Waldbauer]

Country ¹	1937	1938	1939	1940	1941	1942	1943	1944
Argentina (shipments).....	1,346	620	1,051	1,220	2,981	5,622	(?)	(?)
Australia:								
New South Wales ²	162	178	51	64	452	1,469	(?)	(?)
South Australia ²	669	502	615	1,072	1,081	1,026	522	(?)
Western Australia.....	2,947	2,919	3,853	3,561	4,173	3,304	2,351	(?)
Brazil.....	8,400	(?)	(?)	(?)	(?)	(?)	(?)	(?)
Canada (shipments).....	19,365	12,753	11,306	19,464	23,623	20,203	21,644	18,592
Egypt.....	158	199	74	138	52	19	32	(?)
Finland (exports).....	3,232	5,046	5,596	(?)	(?)	(?)	(?)	(?)
France.....	8,900	(?)	(?)	(?)	(?)	(?)	(?)	(?)
Germany: Bavaria.....	9,986	10,419	(?)	(?)	(?)	(?)	(?)	(?)
India, British.....	495	702	501	(?)	1,257	2,100	(?)	(?)
Italy.....	13,437	13,391	12,473	(?)	(?)	(?)	(?)	(?)
Norway (exports).....	32,555	21,761	21,282	(?)	(?)	(?)	(?)	(?)
Rumania.....	2,587	1,690	(?)	(?)	(?)	(?)	(?)	(?)
Sweden.....	49,140	45,111	40,792	22,222	(?)	(?)	(?)	(?)
United States (sold or used)...	272,842	199,267	257,534	295,430	344,299	321,240	313,126	332,663

¹ In addition to countries listed feldspar is produced in China (Manchuria), Czechoslovakia, Madagascar, Palestine, and United Kingdom. Official figures of Czechoslovakia output are not available, but it is estimated that the annual production is approximately 30,000 metric tons (Stat. Comm. Czechoslovak Ceram. Soc.).

² Data not available.

³ Includes some china stone.

ASBESTOS

By OLIVER BOWLES AND D. I. MARSH

SUMMARY OUTLINE

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SUMMARY

Asbestos production in the United States increased considerably in 1944—to 7,558 short tons from 3,945 tons in 1943. Most of the domestic output consists of the shorter grades of chrysotile from Vermont, where operations had been suspended much of 1943 while a new quarry was being opened. Domestic sales totaled 6,667 tons, 11 percent higher than in 1943. Even with this gain in sales, the United States supplied only 1½ percent of domestic requirements.

As in the past, Canada furnished the larger part of United States needs of chrysotile, but much of it consists of shingle stock, paper stock, and other shorter nonspinning grades. Africa supplied a substantial part of the longer grades needed for military and essential civilian applications.

Chrysotile asbestos is important in the military program. The longer fibers are used for sheet packing and textiles. Asbestos textiles have many military uses to which publicity cannot be given at this time. Flameproof navy cable construction, woven friction materials, packings, and gaskets are among the more important well-known uses. Rhodesian C & G1 and C & G2 are preferred where electrical insulation is important, because these fibers are low in iron.

South Africa is virtually the sole source of the amosite and blue (crocidolite) varieties, which have important uses in the military program. Amosite is now employed extensively in manufacturing 85-percent magnesia and other high-temperature molded insulation.

The general situation improved greatly throughout the year. No serious interruption to imports occurred, and the flow of materials both from Canada and Africa was sufficient to meet all current requirements and to build up a reserve for future commitments.

In 1943 a plan was effected whereby the Metals Reserve Co. purchased, on Government account, all imported strategic grades of South African and Rhodesian asbestos for allocation to industry in accordance with the most urgent needs. In 1944 military requirements were reduced, and stocks of asbestos were regarded as adequate for prospective needs. Conditions of supply were so improved that further Government purchases were unnecessary, and they were abandoned when 1944 contracts were completed. On December 8, 1944, the War Production Board amended Order M-79 to remove all restrictions on the use of amosite and Rhodesian chrysotile. All

fibers from Rhodesia and the Union of South Africa were removed from General Import Order M-63 on February 1, 1945.

Tremolite (amphibole) asbestos is in demand for the manufacture of chemical filters, but production is very small. Anthophyllite, another variety of amphibole asbestos, finds limited use for welding-rod coatings, insulating cements, and fillers. Intermittent production is reported from scattered deposits in several States.

Salient statistics for asbestos in 1943 and 1944 are summarized in the following table.

Salient statistics of the asbestos industry in the United States, 1943-44

	1943		1944	
	Short tons	Value	Short tons	Value
Domestic asbestos—				
Produced:				
Chrysotile.....	1,731	(1)	7,187	(1)
Amphibole.....	2,214	(1)	371	(1)
Total produced.....	3,945	(1)	7,558	(1)
Sold or used by producers:				
Chrysotile.....	3,900	\$302,289	6,296	\$375,317
Amphibole.....	2,114	32,526	371	5,017
Total sold or used by producers.....	6,014	334,815	6,667	380,334
Imports (unmanufactured).....	440,255	23,053,524	400,956	18,552,940
Exports (unmanufactured).....	367	36,856	475	68,983
Apparent consumption ¹	² 445,902	² 23,351,483	407,148	18,874,291
Exports of asbestos products.....	(1)	4,877,864	(1)	5,634,916

¹ Figures not available.

² Quantity sold or used by producers, plus imports, minus exports.

³ Revised figures.

The following table shows domestic production of asbestos during recent years according to varieties.

Asbestos sold or used by producers in the United States, 1940-44, by varieties

Year	Chrysotile		Amphibole		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	18,672	\$664,520	1,388	\$9,968	20,060	\$674,508
1941.....	22,439	707,589	1,952	18,164	24,391	725,753
1942.....	13,373	480,245	2,108	18,612	15,481	498,857
1943.....	3,900	302,289	2,114	32,526	6,014	334,815
1944.....	6,296	375,317	371	5,017	6,667	380,334

DOMESTIC INDUSTRY

REVIEW BY STATES

Alaska.—Alaska, for the first time, has joined the commercial producers of asbestos. Deposits of slip-fiber chrysotile have been known for some time in the Dahl Creek area, Kobuk River district, but recently good-quality tremolite has been found in the same region. Some of it has already been introduced into United States markets. An important use is for making chemical filters. It was mined by the Arctic Circle Exploration Co., Candle, Alaska, and sold through Philip S. Hoyt.

An occurrence of paligorskite, an amphibole asbestos classed as mountain leather, has been discovered on Lemesurier Island, Southeastern Alaska. Lenses 6 to 8 inches wide, consisting of matted fibers resembling buckskin, occur in bed seams and cross joints in limestone. Heretofore, mountain leather has appeared only as museum specimens. A large enough tonnage may be available in this region to encourage development of commercial uses for it.

Arizona.—The total tonnage of Arizona asbestos sold in 1944 was less than one-half of that sold in 1943, but the value of sales declined only 20 percent. The higher unit value of sales in 1944 was due to the fact that the market absorbed primarily the better grades. The following companies made sales in 1944: Arizona Chrysotile Asbestos Co., Floyd Brown, Arthur Enders, and Guy Phillips—all of Globe; and Johns-Manville Products Corporation, 22 East 40th St., New York, N. Y., with mine and mill at Chrysotile.

Late in 1944 the Defense Plant Corporation stopped all work on the new custom processing mill at the Pine Top asbestos mine. This project, directed by the Southwestern Asbestos Corporation, was designed to mill and classify asbestos mined throughout the Globe area.

California.—There were two producers of asbestos in California in 1944—Kohler & Chase, miners of short-fiber chrysotile near Monticello, Napa County, and the Powhatan Mining Co. (Woodlawn, Baltimore, Md.), reporting production of tremolite asbestos near Castella, Shasta County—shipping point, Dunsmuir. Total production was much smaller than in 1943.

The Gold Meadows Mining & Milling Co. (Sacramento) reported that production would begin in 1945 at the Bowman mine near Forest-hill, Placer County. The fiber is said to be of the amphibole variety.

Georgia.—The only producer in Georgia in 1944 was the Powhatan Mining Co. from its amphibole asbestos property near Dillard, Rabun County. Philip S. Hoyt reports that several properties, both in Georgia and North Carolina, are awaiting development when labor becomes available.

North Carolina.—Sales of asbestos in North Carolina declined greatly in 1944. The Powhatan Mining Co. procured amphibole fiber from properties at Micaville, Yancey County.

Oregon.—As in previous years, small shipments of high-grade tremolite fiber were shipped from the Flora Winsenberg property at Rogue River, Jackson County. The material is used for filtering chemicals.

Vermont.—The Vermont Asbestos Mines Division of the Ruberoid Co. has opened a new quarry on the eastern shoulder of Belvidere Mountain. The asbestos-bearing rock is conveyed over the mountain to the mill by means of an overhead cableway about 1 mile long. The first large blast, fired in the new quarry about June 1, 1944, uncovered substantial quantities of long slip-fiber chrysotile. A considerable proportion of the fiber is 1 to more than 6 inches long and has superior strength and flexibility. The long asbestos fibers do not occur in isolated pockets but are abundant throughout most of a 400-foot face. Because of its unusual length, the fiber is unsuitable for carding with standard equipment, and tests have been in progress to determine the best methods and equipment to employ and the commercial applications for which the fiber is best adapted. The

discovery is of importance because it represents the only large deposit of long-fiber chrysotile found in the United States up to the present time. The mill served by the cableway operated on a two-shift basis throughout much of the year, as enough labor could not be secured to operate three shifts. Operation is suspended during the severe winter months, but plans are now under way to stock-pile enough asbestos rock to permit winter operation. The output consists chiefly of shingle stock, paper stock, and shorter grades, but spinning fibers are attaining prominence and will doubtless become increasingly important in the future. Production was much greater in 1944 than in 1943 but was still far below the maximum of which the property is capable.

TRENDS IN CONSUMPTION

The accompanying table shows for a 10-year period the domestic consumption of unmanufactured asbestos and the value of exports of asbestos products. Consumption in 1944 declined 9 percent from the record level of 1943 and was the lowest since 1940. The value of exports of asbestos products, however, gained 16 percent and reached the highest point in the history of the industry. The value of asbestos products manufactured in the United States has not been recorded since 1939.

Raw asbestos consumed in and asbestos products exported from the United States, 1935-44

Year	Raw asbestos— apparent consumption (short tons)	Asbestos products— exports (value)	Year	Raw asbestos— apparent consumption (short tons)	Asbestos products— exports (value)
1935.....	174, 655	\$2, 261, 929	1940.....	262, 199	\$3, 473, 248
1936.....	250, 922	2, 479, 273	1941.....	438, 741	4, 835, 194
1937.....	316, 263	3, 047, 078	1942.....	433, 949	5, 116, 919
1938.....	187, 150	2, 533, 916	1943.....	445, 902	4, 877, 864
1939.....	255, 547	3, 354, 920	1944.....	407, 148	5, 634, 916

¹ Revised figures.

As asbestos is used extensively for packings, gaskets, boiler lagging, and pipe covering at industrial plants and as friction material on automotive equipment, the demand for it depends to quite an extent on industrial activity. The building industry also affords an extensive market for asbestos for asbestos-cement products, heat insulation, and fireproofing. The relation of asbestos consumption to industrial production and building construction is indicated in figure 1. The similarity in the trends from 1933 to 1941 is apparent, but in 1942 military construction which dominated all building activities had reached its maximum, and the asbestos industry, operating at almost 100 percent of capacity, was unable to keep pace with it. In 1943 and 1944 military building declined rapidly, and as private construction remained very low the total construction curve dropped precipitously almost to the level of 1935. This condition influenced the downtrend in asbestos consumption to some extent. However, industrial production which was only slightly lower in 1944 than in 1943 absorbed asbestos products in such large quantities that the decline in asbestos consumption was quite moderate.

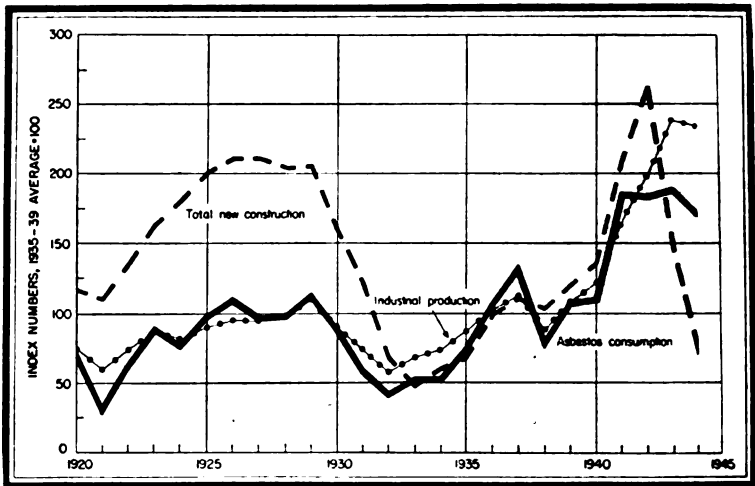


FIGURE 1.—Consumption of asbestos compared with total new construction and industrial production, 1920-44. Units are reduced to percentages of the 1935-39 average. Statistics on value of construction from Bureau of Foreign and Domestic Commerce and on industrial production from Federal Reserve Board.

MARKET CONDITIONS

Market trends were generally downward throughout the year. A moderate curtailment in demands for strategic grades in the military program had no compensating increases in other fields because building activity remained low, and there was virtually no increase in the demand for asbestos used in a multiplicity of products that normally satisfy civilian needs.

PRICES

Prices of asbestos as quoted in E&MJ Metal and Mineral Markets were unchanged throughout the year, as follows:

Per ton, f. o. b. Quebec mines, tax and bags included: Crude No. 1, \$650-\$750; crude No. 2 and sundry crudes, \$165-\$385; spinning fibers, \$124-\$233; magnesia and compressed sheet fibers, \$124-\$146.50; various grades shingle stock, \$62.50-\$85; various grades paper stock, \$44-\$49; cement stock, \$28.50-\$33; floats, \$19.50-\$21; shorts, \$14.50-\$26.50. Quotations in U. S. currency.

Per ton, f. o. b. Hyde Park, Vt.: Shingle fiber, \$62.50-\$65.50; paper stock fiber, \$44-\$53; waste, \$33; shorts, \$14.50-\$28.50; floats, \$19.50.

The following ceiling prices fixed by the Office of Price Administration for certain African fibers sold by the Metals Reserve Co. were effective in 1944: Rhodesian chrysotile C & G1 \$330, C & G2 \$236, and C & G3 \$146.50; amosite B1 \$149, B3 or D3 \$123, 3DM1 \$118, M1 \$113. These prices are per short ton at the dock in the United States. These were in effect throughout the year, but in the late summer the actual selling price of C & G3 by the Metals Reserve Co. was reduced to \$130 a ton, f. o. b. warehouse.

NEW DEVELOPMENTS

A new fire-resistant textile has been developed consisting of 72 percent asbestos, 22 percent glass fiber, and 6 percent cotton yarn. It has only half the weight per square yard of conventional asbestos cloth but has the same strength. It combines the superior flexibility of asbestos with the high tensile strength of glass wool.

Another new product under development for some time reached the commercial production stage in 1944. It is classed as a lime-silica high-temperature insulation. It contains 15 percent of asbestos fiber as a binder, and its temperature limit is said to be about 1,200° F.

POSTWAR OUTLOOK

Asbestos has a multitude of uses, and most of its applications during wartimes have their peacetime counterparts. No asbestos mines in the world were damaged by war. Nearly all worked at capacity during the war period. All mines will be available at the close of the war to supply raw material to asbestos-product factories throughout the world. Although war demands for asbestos will diminish (they have already declined greatly in the field of Navy cable construction, for example) peacetime needs will create an enlarged demand. Asbestos-products plants in occupied countries that have been unable to obtain raw material will need large supplies. Early in 1945 an order was placed for 3,085 tons of Canadian spinning and shingle fibers to be shipped to France. This is doubtless a forerunner of many similar orders as Belgium, Holland, Italy, and other countries take steps to reestablish their industries. New factories are also in prospect for making asbestos-cement products in Mexico, South and Central America, Australasia, and the United States. It is reported that 13 asbestos-cement-products plants are now in operation in Central and South America. Reconversion of automobile factories to the manufacture of commercial and pleasure vehicles will shift the demand for friction materials from military to civilian needs. The enormous backlog of residential and commercial building foreshadows a huge demand for asbestos-cement products. It is evident therefore that, although transition from a wartime to a peacetime economy may shift the emphasis of asbestos requirements from certain fields of use to others, the general effect will be an increasing demand, particularly for shingle-stock and cement-stock grades.

The demand for spinning fibers in the immediate postwar period probably will be strong, but from the long-range viewpoint these grades have a less promising future than the shorter fibers. There have been no noteworthy new developments that point to an expansion in use of asbestos textile products. On the other hand, there is a decided drift from woven to molded brake linings, and from woven gaskets and packings to other types that employ shorter-grade fiber. Some competition from fibrous glass is to be expected, but it is quite unlikely that glass will invade the field of friction materials or packings. Spinning fibers generally constitute a minor part of the output of asbestos mines; nevertheless, they are the most profitable products, and the prospect of reduced demand for them is a problem worthy of careful consideration by all asbestos producers.

FOREIGN TRADE¹

The following table shows imports of unmanufactured asbestos into the United States in 1943 and 1944. Total imports show a decline of 9 percent in quantity and nearly 20 percent in value. The largest relative declines were in imports from Rhodesia and the Union of South Africa. Imports from all major sources except Soviet Russia were less in 1944 than in 1943. Receipts from that source increased greatly. The general decline in imports of the better grades of fiber reflects the improved supply situation with respect to military and essential civilian needs.

Asbestos (unmanufactured) imported for consumption in the United States, 1943-44, by countries and classes

Country	Crude (including blue fiber)		Mill fibers		Short fibers ¹		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1943								
Africa:								
Mozambique.....	802	\$106,564	-----	-----	-----	-----	802	\$106,564
Southern Rhodesia.....	28,555	3,768,346	-----	-----	-----	-----	28,555	3,768,346
Union of South Africa.....	24,007	2,379,879	-----	-----	2	\$61	24,009	2,379,940
Australia.....	3	1,018	-----	-----	-----	-----	3	1,018
Bolivia.....	22	1,805	-----	-----	-----	-----	22	1,805
Canada.....	1,870	708,282	161,783	\$10,849,793	222,002	5,128,900	385,655	16,687,065
India and Dependencies.....	65	38,034	-----	-----	-----	-----	65	38,034
U. S. S. R.....	302	21,050	842	49,702	-----	-----	1,144	70,752
	55,626	7,024,978	162,625	10,899,495	222,004	5,129,051	440,255	23,053,524
1944								
Africa:								
Southern Rhodesia.....	7,966	1,522,825	-----	-----	-----	-----	7,966	1,522,825
Union of South Africa.....	19,162	1,859,982	-----	-----	-----	-----	19,162	1,859,982
Bolivia.....	15	1,905	-----	-----	-----	-----	15	1,905
Canada.....	1,528	564,545	145,791	9,767,627	205,909	4,720,939	353,228	15,053,111
Chile.....	14	1,118	-----	-----	-----	-----	14	1,118
U. S. S. R.....	-----	-----	20,570	113,390	-----	-----	20,570	113,390
United Kingdom of Great Britain and Northern Ireland.....	-----	-----	1	609	-----	-----	1	609
	28,685	3,950,375	166,362	9,881,626	205,909	4,720,939	400,956	18,552,940

¹ Asbestos, n. e. s., containing not over 15 percent foreign matter.

The following table shows imports and exports of unmanufactured asbestos for the 5-year period 1940-44.

Asbestos (unmanufactured) imported for consumption in and exported from the United States, 1940-44

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1940.....	246,613	\$10,034,433	4,474	\$449,105
1941.....	419,196	17,909,077	4,846	325,825
1942.....	419,242	21,217,650	774	134,411
1943.....	440,255	23,053,524	367	36,856
1944.....	400,956	18,552,940	475	58,953

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

The following table shows exports of asbestos products in 1943 and 1944.

Manufactured asbestos products exported from the United States, 1943-44, by kinds

Product	1943		1944	
	Quantity	Value	Quantity	Value
Brake lining:				
Molded and semimolded.....short tons..	771	\$1, 138, 469	1, 035	\$1, 467, 692
Not molded.....linear feet..	353, 892	195, 888	321, 019	193, 443
Clutch facings.....number..	1, 282, 190	554, 561	1, 412, 600	567, 974
Paper, millboard, and roll board.....short tons..	869	107, 060	773	127, 841
Pipe covering and cement.....do.....	1, 384	186, 462	1, 738	264, 199
Textiles, yarn, and packing.....do.....	975	1, 132, 411	1, 096	1, 352, 790
Asbestos roofing.....squares..	54, 896	305, 243	59, 580	438, 800
Other asbestos manufactures, except roofing short tons..	2, 815	640, 818	5, 353	957, 536
Magnesia and manufactures.....do.....	7, 135	616, 952	1, 217	264, 641
		4, 577, 864		5, 634, 916

WORLD PRODUCTION¹

Production of asbestos throughout the world, by countries, from 1937 to 1944, insofar as figures are available, is indicated in the following table.

World production of asbestos, 1937-44, by countries, in metric tons¹

Country ¹	1937	1938	1939	1940	1941	1942	1943	1944
Argentina.....			110	150	84	51	(?)	(?)
Australia:								
New South Wales.....				9	38	39	(?)	(?)
South Australia.....	123	49	46	119	152	64	11	(?)
Tasmania.....	2	4			4	7	19	(?)
Western Australia.....	43	123	279	370	62	121	247	(?)
Bolivia.....	21	21	2	71	211	58	22	13
Brazil.....		120	45	500	13	(?)	(?)	(?)
Canada ⁴	371, 967	262, 894	330, 642	313, 504	433, 492	398, 669	423, 831	380, 349
China.....	(?)	(?)	(?)	100	(?)	(?)	(?)	(?)
Chosen.....	70	(?)	(?)	(?)	(?)	(?)	(?)	(?)
Cyprus (exports).....	11, 892	5, 668	10, 377	9, 673	4, 874	3, 503	1, 332	(?)
Finland ⁶	7, 260	(?)	(?)	(?)	(?)	(?)	(?)	(?)
France.....	250	(?)	(?)	(?)	(?)	(?)	(?)	(?)
French Morocco.....						116	182	(?)
Greece.....	2	85	(?)	(?)	(?)	(?)	(?)	(?)
India, British.....	102	90	266	1	372	514	59	(?)
Indochina.....	5		(?)	(?)	(?)	(?)	(?)	(?)
Italy.....	6, 393	6, 860	(?)	(?)	(?)	(?)	(?)	(?)
Japan (approximate).....	1, 000	1, 000	1, 000	1, 000	(?)	(?)	(?)	(?)
Kenya Colony.....		5	(?)	(?)	213	307	321	(?)
New Zealand.....	(?)	(?)	(?)		54	43	190	(?)
Southern Rhodesia.....	51, 722	53, 352	52, 900	52, 518	49, 191	56, 546	51, 149	(?)
Swaziland.....			7, 233	18, 873	19, 166	23, 219	17, 179	29, 628
Turkey.....	157	668	88	99	146	295	133	(?)
Uganda.....		53	(?)	(?)	(?)	(?)	(?)	(?)
Union of South Africa.....	25, 975	21, 025	20, 003	24, 849	25, 655	31, 351	32, 351	16, 130
U. S. S. R.....	125, 000	86, 000	(?)	(?)	(?)	(?)	(?)	(?)
United States (sold or used by producers).....	10, 958	9, 471	14, 024	18, 198	22, 127	14, 044	5, 456	6, 04
Venezuela.....	(?)	(?)	(?)	20	(?)	(?)	(?)	(?)

¹ In addition to countries listed asbestos is produced in Algeria, Bulgaria, Czechoslovakia, Egypt, Madagascar, Spain, and Switzerland.

² Data not available.

³ Exports.

⁴ Exclusive of sand, gravel, and stone (waste rock only), production of which is reported as follows: 1937, 3,611 tons; 1938, 2,975 tons; 1939, 3,535 tons; 1940, 5,880 tons; 1941, 7,669 tons; 1942, 7,339 tons; 1943-44, data not available.

⁵ Includes asbestos flour.

⁶ Imports into United States.

⁷ Preliminary.

⁸ January to June, inclusive.

⁹ Statistics compiled by B. B. Waldbauer.

CANADA

The Canadian asbestos industry is centered in the Thetford Mines area of the Province of Quebec. Although operations have been conducted on a large scale for many years the reserves are still very great. War demands for the longer grades were strong throughout the year both in the United States and in Great Britain, but building construction was so curtailed that demands for the shorter grades, particularly cement stock, were reduced. As most of the Canadian production is of the shorter grades, the output declined about 10 percent compared with 1943. The falling off in production of crude fibers is noteworthy. Production of crudes in 1944 fell below 2,000 tons for the first time since the early days of the industry. Operations at the King mine of the Asbestos Corporation, Ltd., have been described in some detail.³

Canadian Johns-Manville has undertaken an extensive program of underground mining by the block-caving method. Shaft sinking is now in progress.

The following figures have been released by the Dominion Bureau of Statistics.

Sales of asbestos in Canada, 1943-44, by grades

	1943			1944		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Grade:						
Crudes.....	2, 016	\$888, 099	\$440. 53	1, 547	\$621, 956	\$402. 04
Fibers.....	217, 889	16, 071, 843	73. 76	190, 233	14, 305, 966	75. 20
Shorts.....	247, 291	6, 209, 563	25. 11	227, 486	5, 601, 594	25. 02
	467, 196	23, 169, 505	49. 59	419, 265	20, 619, 516	49. 18
Rock mined.....	7, 929, 469	.....	.....	7, 778, 806	.....	.....
Rock milled.....	6, 828, 532	.....	.....	6, 587, 740	.....	.....

AFRICA

North Africa.—A deposit of chrysotile is reported at Bou Asser, French Morocco. Reports received by the Bureau of Mines show production of 116 metric tons in 1942 and 182 tons in 1943. A sample received by the Bureau is a section of a cross-fiber vein having fibers about 2 inches long and apparently of good spinning quality. It is used locally in the manufacture of building products at Casablanca.

Southern Rhodesia.—No figures for Rhodesian asbestos production have been published since May 1940. Export data, which are available for certain years, are an approximate measure of production because local consumption is quite small. The following table shows export figures now at hand.

³ McLaren, D. C., The King Asbestos Mine: Canadian Min. Jour., October 1944, pp. 683-687.

Asbestos exported from Southern Rhodesia, 1940-44

Year	Short tons	Value	Year	Short tons	Value
1940.....	57,891	£1,419,566	1943.....	56,382	£1,827,387
1941.....	54,224	1,419,405	1944.....	(¹)	(¹)
1942.....	62,332	1,811,042			

¹ Data not available.

Swaziland.—Since June 1939 the Havelock mine in Swaziland has been an important producer of chrysotile. Production during recent years in metric tons is indicated in the preceding World table.

Union of South Africa.—Amosite, the principal variety of asbestos mined in the Union of South Africa, is produced nowhere in the world except in the Transvaal. Crocidolite (blue asbestos) is also an important product. Chrysotile production was important a few years ago, but the deposits then worked are virtually exhausted.

Asbestos produced in and exported from the Union of South Africa, 1940-44

Year	Production (short tons)				Exports	
	Transvaal	Cape Province	Natal	Total	Short tons	Value
1940.....	21,011	6,381	(¹)	27,392	43,482	£934,417
1941.....	21,704	6,576	(¹)	28,280	43,588	990,756
1942.....	27,278	7,281	(¹)	34,559	55,223	1,348,977
1943.....	27,773	7,888	(¹)	35,661	35,940	880,019
1944 ²	14,152	3,628	(¹)	17,780	14,329	337,977

¹ Data not available.² Partly estimated.³ Subject to revision.⁴ January to June, inclusive.

Four varieties of asbestos are marketed in the Union. The following table shows the tonnage of each variety from 1940 to 1944, insofar as data are available.

Asbestos produced in the Union of South Africa, 1940-44, by varieties and sources, in short tons¹

Variety and source	1940	1941 ²	1942	1943	1944 ³
Amosite (Transvaal).....	17,767	19,211	24,924	23,194	11,994
Chrysotile (Transvaal).....	646	1,658	1,917	2,034	1,123
Blue (Transvaal).....	2,520	776	360	2,456	1,003
Blue (Cape).....	6,381	6,576	7,281	7,888	3,628
Anthophyllite (Transvaal).....	78	59	77	89	22
	27,392	28,280	34,559	35,661	17,780

¹ Data from Union of South Africa, Department of Mines, Quarterly Reports.² Partly estimated.³ January to June, inclusive.

OTHER COUNTRIES

No recent data on the Russian asbestos industry are available.

According to reports received by the Bureau of Mines, Turkey has produced small quantities of asbestos as follows. Quantities are metric tons, and values (in parentheses) are Turkish lira: 1940, 99 (2940); 1941, 146 (4380); 1942, 295 (14650); and 1943, 133 (12502).

The new asbestos mill near Tinaquillo, Venezuela, under construction for some time, has not been completed.

BARITE, WITHERITE, AND BARIUM CHEMICALS

By CHARLES L. HARNESS AND F. M. BARSIGIAN ¹

SUMMARY OUTLINE

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SUMMARY

Record quantities of barite were produced and consumed in the United States during 1944. Output was 515,136 short tons—20 percent over 1943 and 7 percent greater than in the previous record year 1941. Consumption (595,563 tons) included 67,888 tons of imports, largely from Nova Scotia. The greatest increase in production was in Arkansas, where two barite-flotation plants expanded their capacity early in the year in response to an accelerated demand for barite in oil-well drilling muds. Production was also up in Missouri, assisted by a rise in price ceiling from \$7 to \$8.50 a short ton of crude barite and by wage increases from 10 to 15 cents an hour. Despite the exhaustion of one of the larger deposits in Georgia, production was higher than in 1943. Tennessee output was down owing to price and labor difficulties. Equipment shortages worked hardships on producers, particularly in Missouri and eastward. Lack of tires and trucks was the major complaint. In the West, production was easier, though labor was likewise scarce. The main producer on the West coast was threatened with a shutdown when its carrier, the Yosemite Valley Railroad, filed a petition to abandon with the Interstate Commerce Commission. The action is pending.

Stocks of crude barite in the hands of producers at the end of the year were low in the East but adequate in the West. Late in the year some material was shipped East from a Nevada stock pile.

Sales of ground and crushed barite reached a new record, 344,757 short tons—a 66-percent increase over 1943. Grinding activity for the Gulf market was intense. In addition to expansions in the two Arkansas flotation plants, a new grinding mill was erected in Missouri. Well drilling is now the largest use of barite, taking 54 percent of crude production in 1944. Despite the increase in production, an unprecedented number of wells blew out in 1944, indicating that some drillers

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

at times were rushing their programs ahead of barite availability. Crushed barite, used mainly for glass, was likewise in short supply.

War demands continued to drive the barium-chemicals industry to the highest levels permitted by the shortage of barite and manpower. Barium nitrate production, negligible before the war, was in demand for the new thermate incendiary bombs destined for Japan. Barium chloride and carbonate were required for heat-treating metal parts. Much barium sulfate was used in coating photographic papers for the services. Demand for lithopone was greater than supply.

Salient statistics of the barite, witherite, and barium-chemical industries in the United States, 1940-44

	1940	1941	1942	1943	1944
Barite:					
Crude (primary):					
Produced..... short tons.....	390, 462	483, 391	449, 873	429, 298	515, 136
Sold or used by producers:					
Short tons.....	409, 353	503, 156	429, 484	420, 343	518, 617
Value: ¹					
Total.....	\$2, 596, 743	\$3, 134, 234	\$2, 673, 002	\$2, 796, 776	\$3, 558, 489
Average.....	\$6. 34	\$6. 23	\$6. 22	\$6. 65	\$6. 86
Imports for consumption:					
Short tons.....	7, 391	456	4, 680	-----	67, 888
Value: ¹					
Total.....	\$41, 342	\$2, 518	\$34, 756	-----	\$459, 604
Average.....	\$5. 59	\$5. 52	\$7. 43	-----	\$6. 77
Apparent new supply ² short tons.....	416, 744	503, 612	434, 164	420, 343	586, 505
Domestic..... percent.....	98. 2	99. 9	98. 9	100	88. 4
Reported consumption (total)..... short tons.....	404, 388	490, 833	449, 424	⁴ 453, 744	595, 563
Ground (and crushed):					
Sold or used by producers:					
Short tons.....	184, 390	234, 877	178, 765	208, 252	344, 757
Value.....	\$3, 697, 806	\$4, 606, 832	\$3, 611, 745	\$3, 743, 919	\$5, 455, 835
Imports for consumption:					
Short tons.....	314	-----	-----	-----	11, 964
Value.....	\$3, 299	-----	-----	-----	\$243, 917
Witherite:					
Imports for consumption:					
Short tons.....	3, 584	4, 790	3, 066	448	-----
Value.....	\$70, 126	\$107, 238	\$50, 824	\$9, 452	-----
Barium chemicals:					
Sold by producers:					
Short tons.....	(⁵)	⁶ 71, 319	⁶ 70, 610	⁶ 77, 869	73, 470
Value.....	(⁵)	⁶ \$5, 807, 175	⁶ \$7, 405, 770	⁶ \$8, 314, 537	\$7, 740, 318
Imports for consumption:					
Short tons.....	191	317	385	212	95
Value.....	\$9, 045	\$15, 944	\$105, 275	\$33, 120	\$7, 382
Lithopone:					
Sold or used by producers: ⁷					
Short tons.....	151, 802	176, 642	137, 320	135, 723	142, 905
Value.....	\$10, 197, 897	\$12, 550, 193	\$10, 828, 924	\$10, 745, 305	\$11, 208, 891
Exports of lithopone:					
Short tons.....	14, 298	21, 527	17, 026	17, 320	11, 551
Value.....	\$1, 112, 362	\$2, 079, 229	\$1, 733, 698	\$1, 637, 217	\$1, 106, 430

¹ F. o. b. mine shipping point.

² Declared value f. o. b. foreign market.

³ Barite sold or used by producers plus imports.

⁴ Revised figures.

⁵ Comparable data not available.

⁶ Revised figures; see table "Barium chemicals produced and used or sold by producers in the United States, 1941-44."

⁷ Exclusive of cadmium lithopone.

BARITE

CRUDE

PRODUCTION AND CONSUMPTION

With isolated exceptions, the measures taken in 1943-44 by the War Production Board, the Office of Price Administration, and the War Labor Board to increase barite production bore fruit. The labor

shortage was eased to some extent by wage increases approved by the War Labor Board first in the Tennessee-Georgia area,² then in Missouri. Based on these increased production costs the Office of Price Administration permitted increases in the ceiling price of barite in Tennessee, Georgia, and Missouri.

The consumption of barite in 1944 was 595,563 short tons, distributed as follows: For well drilling, 277,792; for chemicals, 100,921; for lithopone, 134,597; for glass, 24,153; for paint filler, 23,000; for rubber filler 10,000; and for other purposes, including grinding losses, 25,100.

The apparent new supply of barite in the United States since (production plus imports) is shown in figure 1.

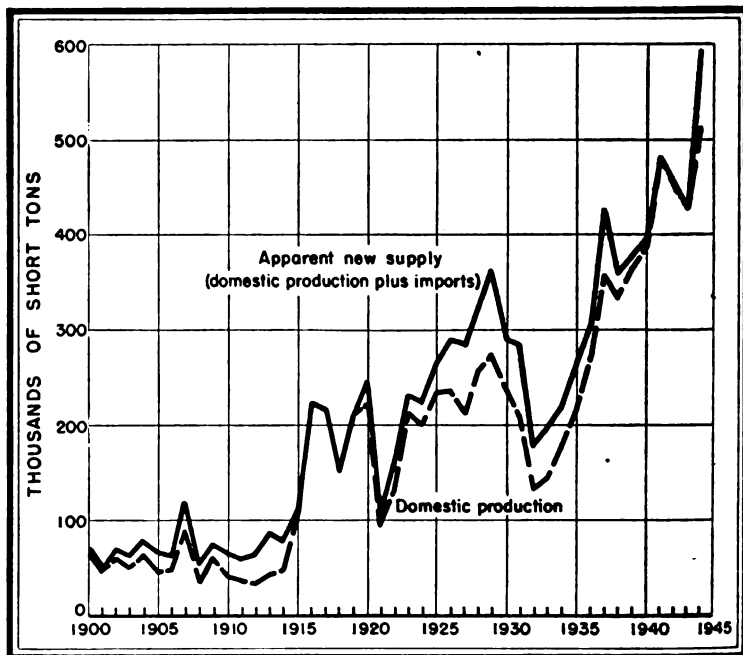


FIGURE 1.—Apparent new supply of barite in the United States, 1900-1944.

Spurred by well-drilling requirements, Magnet Cove Barium Corp. completed a second flotation plant at Malvern, Ark., and the National Lead Co. expanded several units in its existing plant. The Bureau of Mines diamond-drilled the Magnet Cove, Ark., area extensively and mapped out additional reserves of several million tons.

Industrial Minerals & Chemical Co. has stripped thousands of tons of barite at its Spanish mine near Washington, Nevada County, Calif., since 1940, and about 10,000 tons remain to be mined before further stripping is required. The producer states that total reserves may reach 200,000 tons. Barite produced here is used in barium chemicals and well drilling. A very high grade material is offered for use in glass, paint, and white rubber goods.

The L. A. Wood Co. removed the last minable barite from its Cartersville (Ga.) open-cut in February 1945. This cut was mined

² Bureau of Mines Minerals Yearbook, 1943, p. 1488.

for years by the Barium Reduction Corp. followed by the Cartersville Barium Co., then the L. A. Wood Co. Barite produced here was converted to black ash in Cartersville for shipment to a barium-chemicals manufacturer, and the loss of production was keenly felt in the early months of 1945.

Several new washers were built or building in 1944 in the Washington County area of Missouri. The National Lead Co. built two washers of radical bowl design, intended to reduce loss of fines. De Soto Mining Co. and Cordia Mining Co. completed new washers. The L. A. Wood Co. of Sweetwater, Tenn., bought out the M. & B. Mining Co. at Palmer, Mo., and also planned to build an additional washer, closer to the Potosi area. Other new washers were operated by Superior Minerals Co. at Richwoods, Mo., and Star Mining Co. at Potosi, Mo.

A new grinding plant was erected for the well-drilling trade by Eversole Maclay, Mineral Point, Mo.

The Clinchfield Sand & Feldspar Corp. reopened barite veins near Del Rio in Cocke County (Burnett Station, Southern Railway) and is shipping filler-grade barite to Kings Creek, S. C., for grinding and sale.

Crude (primary) barite sold or used by producers in the United States, 1943-44, by States

State	1943		1944	
	Short tons	Value	Short tons	Value
Georgia.....	98,680	\$621,193	108,851	\$929,090
Missouri.....	124,147	872,044	150,748	1,121,678
Nevada.....	12,157	49,900	22,390	84,859
Tennessee.....	52,593	383,007	43,033	279,567
Other States ¹	132,766	870,632	193,595	1,143,295
	420,343	2,796,776	518,617	3,558,489

¹ 1943: Arizona, Arkansas, California, Kentucky, and South Carolina; 1944: Arkansas, California, North Carolina, and South Carolina.

Producers of crude barite and witherite in the United States in 1944

[Producers of less than 1,000 short tons not included]

Name and address	Mine or mill location (nearest town)	Method of recovery
ARKANSAS:		
Baroid Sales Division, National Lead Co., 830 Ducommun St., Los Angeles 12, Calif.	Malvern.....	Flotation.
Magnet Cove Barium Corp., Malvern.....	do.....	Do.
CALIFORNIA:		
Baroid Sales Division, National Lead Co., 830 Ducommun St., Los Angeles.	El Portal.....	Shot from veins (barite and witherite).
Industrial Minerals & Chemical Co., 6th and Gilman Sts., Berkeley.	Washington.....	Shot from veins.
GEORGIA:		
Barytes Mining Co., Box 224, Cartersville	Cartersville.....	Washer.
Dellinger, Brown, & Duckett, Cartersville	do.....	Do.
T. E. Johnsey, Cartersville	do.....	Do.
New Riverside Ochre Co., Cartersville	do.....	Do.
Paga Mining Co., Cartersville	do.....	Do.
George E. Shropshire, Cartersville	do.....	Do.
L. A. Wood Co., Sweetwater, Tenn.	do.....	Do.
MISSOURI:		
Cadet Mining Co., Cadet.....	Cadet.....	Do.
Campbell Bros., Russellville	Cole Camp.....	Do.
Do.....	Russellville.....	Do.
J. E. Carter Mining Co., Potosi	Potosi.....	Do.
Cordia Mining Co., Potosi	Mineral Point.....	Do.
De Soto Mining Co., De Soto	Richwoods.....	Do.
H. & P. Mining Co., Potosi	Old Mines.....	Do.

Producers of crude barite and witherite in the United States in 1944—Continued

[Producers of less than 1,000 short tons not included]

Name and address	Mine or mill location (nearest town)	Method of recovery
Missouri—Continued.		
Hanenkratt, Gravel Co., 5202 Brookwood St., Kansas City	Linn Creek	Washer.
Fred Hornsey & Co., Potosi	Potosi	Do.
M. & B. Mining Co., Potosi	Old Mines	Hand-mined.
Midwest Mining Co., Box 87, Potosi	Richwoods	Washer.
Ozark Products Co., Box 190, Potosi	Cadet	Do.
Lloyd Sestak, Henley	Henley	Do.
Superior Mineral Co., Cadet	Cadet	Do.
Do.	Richwoods	Do.
Whaley & Scott Mining Co., Box 111, De Soto	do	Do.
Xact Clays, Inc., Box 306, Potosi	Potosi	Do.
NEVADA:		
Barium Products, Ltd., Newark, Calif.	Battle Mountain	Shot from veins.
California-Nevada Barytes Mines Division of the Glidden Co., 766 50th Ave., Oakland, Calif.	do	Do.
SOUTH CAROLINA:		
Clinchfield Sand & Feldspar Corp., 618 Mercantile Trust Bldg., Baltimore 2, Md.	Kings Creek	Do.
TENNESSEE:		
Clinchfield Sand & Feldspar Corp., 618 Mercantile Trust Bldg., Baltimore 2, Md.	Del Rio	Do.
Sweetwater Mining Co., Sweetwater	Sweetwater	Washer.
Wolf River Corp., Jamestown	do	Do.
L. A. Wood Co., Sweetwater	do	Do.
R. E. Wood, Sweetwater	do	Do.

Crude barite (domestic and imported) used in the manufacture of ground barite and barium chemicals in the United States, 1940-44, in short tons

Year	In manufacture of—			Total	Year	In manufacture of—			Total
	Ground barite ¹	Lithopone	Barium chemicals			Ground barite ¹	Lithopone	Barium chemicals	
1940.....	200,899	136,885	66,604	404,388	1943.....	225,154	² 129,493	² 99,097	² 453,744
1941.....	243,846	153,982	93,005	490,833	1944.....	360,045	134,597	100,921	595,563
1942.....	200,443	144,821	104,160	449,424					

¹ Includes some crushed barite.² Revised figures.*Distribution of plants producing ground and crushed barite, lithopone, and barium chemicals and total consumption of crude barite and witherite in the United States in 1944, by States*

State	Product manufactured	Plants ¹	Barite used (short tons)
Missouri.....	Ground barite and chemicals.....	5	117,247
California.....	Ground barite, lithopone, and chemicals.....	4	61,237
Delaware and New Jersey.....	do.....	5	50,689
Illinois.....	do.....	6	53,212
Georgia.....	Ground and crushed barite, and chemicals.....	4	49,471
Ohio.....	Chemicals.....	1	
West Virginia.....	do.....	2	
Kansas.....	Lithopone.....	1	
Maryland.....	do.....	1	
Pennsylvania.....	do.....	1	
New York.....	Ground barite and chemicals.....	2	
Arkansas.....	Ground and crushed barite.....	2	
South Carolina.....	do.....	1	
Tennessee.....	Crushed barite.....	3	
		38	595,563

¹ A plant producing more than 1 product is counted but once in arriving at State totals.

PRICES

Prices in Tennessee, Georgia, and Missouri were higher in accordance with the new ceilings established by the Office of Price Administration April 8 and July 26, 1944. Under the new ceilings chemical-grade barite in Georgia and Tennessee may be sold at \$10, \$10.50, or \$11 a long ton, f. o. b. washer loading point, depending on the individual producer. On glass barite the L. A. Wood Co. was given a ceiling of \$12.50 a long ton, f. o. b. Sweetwater, Tenn., or Cartersville, Ga., and New Riverside Ochre Co., a ceiling of \$11.50 a short ton, f. o. b. Cartersville. The Missouri ceiling of \$8.50 a short ton applies to all Missouri producers, and differences in grade are accounted for by a premium-penalty system.³

WORLD PRODUCTION

Data on production of barite in foreign countries have been meager since the outbreak of war. Germany was the world's largest producer in prewar years, furnishing about half the output. Now it appears likely that loss of foreign markets for German crude barite, lithopone, and barium chemicals and the recent production increases in Arkansas have placed Germany second to the United States.

World production of barite, 1937-44, by countries, in metric tons¹

[Compiled by B. B. Waldbauer]

Country ¹	1937	1938	1939	1940	1941	1942	1943	1944
Algeria.....	2,137	3,069	(²)	(²)	2,580	2,753	2,988	(²)
Argentina.....			768	2,680	4,174	7,083	(²)	(²)
Australia.....	3,152	3,231	4,216	5,047	4,990	6,512	(²)	(²)
Brazil (exports).....	600	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Canada.....			(²)	307	6,250	17,842	22,202	103,770
Chosen.....	8,400	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Cuba.....	3,849		12,000	16,105	13,223	13,787	13,158	14,787
Egypt.....	51	20	31	61	30	60	76	19
France.....	19,850	(²)	(²)	2,246	4,494	9,563	5,589	2,513
Germany:								
Austria.....	855	373	(²)	(²)	(²)	(²)	(²)	(²)
Baden.....	21,653	36,305	(²)	(²)	(²)	(²)	(²)	(²)
Bavaria.....	11,832	26,748	(²)	(²)	(²)	(²)	(²)	(²)
Prussia ⁴	410,634	401,906	(²)	(²)	(²)	(²)	(²)	(²)
Saxony.....	432	230	(²)	(²)	(²)	(²)	(²)	(²)
Thuringia.....	6,790	15,315	(²)	(²)	(²)	(²)	(²)	(²)
Württemberg.....	192		(²)	(²)	(²)	(²)	(²)	(²)
Greece.....	39,343	34,700	24,055	(²)	(²)	(²)	(²)	(²)
India, British.....	15,941	8,205	9,404	(²)	23,844	11,462	(²)	(²)
Indochina.....	45	50	155	185	(²)	(²)	(²)	(²)
Italy.....	45,202	48,169	53,893	(²)	(²)	(²)	(²)	(²)
Norway.....	70		(²)	(²)	(²)	(²)	(²)	(²)
Portugal.....	113	24	25	20	46	(²)	1	(²)
Southern Rhodesia.....		91	50	(²)	(²)	(²)	(²)	(²)
Spain.....		500	8,850	9,936	8,125	7,801	6,309	14,300
Switzerland.....						256	288	233
Union of South Africa.....	570	491	430	691	1,390	745	2,740	11,632
United Kingdom.....	74,485	77,543	96,333	126,331	103,167	100,312	102,736	(²)
United States.....	327,380	304,298	331,910	354,219	438,523	408,116	389,451	467,321

¹ In addition to the countries listed barite is produced in China, Czechoslovakia, Eire, Japan, and U. S. S. R., but data on production are not available.

² Data not available.

³ Exports.

⁴ Official figures which, it is reported, cover only output of mines included under the mining law.

⁵ Estimate.

⁶ January to June, inclusive.

⁷ Includes witherite.

⁸ Office of Price Administration Amendment 6 to M. P. R. 327; July 26, 1944.

GROUND (AND CRUSHED)

SALES

The footage of high-pressure oil wells drilled in 1944 was about 90 percent greater than in 1943. Accordingly, a substantial increase in shipments of ground barite to the oil fields was not unexpected. Barite is mixed in rotary drilling muds to exert back pressure on high-pressure oil and gas formations. About 5 tons of barite is used for each 1,000 feet of high-pressure drilling, and the cautious driller will suspend operations unless he has adequate stocks of barite on hand or knows that he can get it. Nevertheless, there was an unprecedented wave of blow-outs in 1944, some of which may have been caused by lack of barite.

Late in 1943 and early in 1944 the shortage of crushed barite for use in glass was so severe that glassmakers resorted to less-desirable ground well-drilling grades. Production of the crushed grade increased later in the year, however, releasing the well-drilling grades to the oil fields, where they were badly needed.

Ground (and crushed) barite sold or used by producers in the United States, 1940-44

	1940	1941	1942	1943	1944
Plants.....	16	16	19	18	19
Short tons.....	184,390	234,877	178,765	208,252	344,757
Value.....	\$3,697,806	\$4,606,832	\$3,611,745	\$3,743,919	\$5,455,835

A considerable quantity of ground barite is bleached for use as a filler in white paints, rubber, cloth, wall paper, printing ink, and plastics. Unbleached barite may be used where a brown filler is permissible—for example, in linoleum, phonograph records, rope finishing, asbestos brake lining, dark paints, and rubber.

Ground (and crushed) barite sold or used by producers, 1942-44, by consuming industries

Industry	1942		1943		1944	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Well drilling.....	117,380	66	144,452	69	277,792	80
Paint.....	18,484	10	15,000	7	23,000	7
Glass.....	21,895	12	25,464	12	24,153	7
Rubber.....	6,334	4	8,000	4	10,000	3
Undistributed.....	14,672	8	15,336	8	9,812	3
	178,765	100	208,252	100	344,757	100

In the foregoing table figures for consumption of ground barite in "Paint," "Rubber," and "Undistributed" have been estimated partly by the grinders and partly by the Bureau of Mines.

PRICES

The average price per short ton of ground barite—\$15.83 in 1944 and \$17.98 in 1943—was much lower than in 1942 and previous years, when a royalty of \$13 per ton was included in the price of barite used

in well drilling. The patent on which the royalty was based expired in 1943. Ground, bleached barite, according to the Oil, Paint, and Drug Reporter, was quoted at \$25.35 a short ton in bags, carlots, at St. Louis, Mo. Unbleached material was quoted at \$17.50 a short ton f. o. b. producing plant. Crushed barite for glass was sold under ceilings of \$11.50, \$12.50, and \$13 a long ton f. o. b. producing plants in Georgia and Tennessee, depending on the producer: A differential of about \$2 a ton was generally added for bagging.

WITHERITE

Little or no commercial witherite was on the market in 1944. None was imported from England—normally the world source—and the industry used the more expensive precipitated barium carbonate as an antiscumming agent in ceramics. The Baroid Sales Division of the National Lead Co. mined a mixed witherite-barite near El Portal, Calif., and ground the material without separation for oil-well drilling muds. The production of this mixture is reported as barite.

Witherite, crude, unground, imported for consumption in the United States, 1940-44

(Value at point of shipment)

Year	Short tons	Value	Year	Short tons	Value
1940.....	3,584	\$70,126	1943.....	448	\$9,452
1941.....	4,790	107,238	1944.....		
1942.....	3,066	60,824			

According to the Oil, Paint and Drug Reporter, witherite, 99 per cent through 200-mesh, bags, carlots, works, was nominally quoted at \$43 a short ton in 1944.

BARIUM CHEMICALS

PRODUCTION

Barium chemicals are used directly or indirectly for many war and essential civilian purposes. Lithopone was in heavy demand in 1944 and helped to relieve shortages of the more opaque titanium, zinc, and lead pigments. Barium chloride is one of the principal barium salts. Besides being a source of other barium chemicals, it is used in heat-treating steel, in purifying salt brines for chlorine and sodium hydroxide manufacture, and in the manufacture of coatings for photographic paper. Blanc fixe (precipitated barium sulfate) is used as a filler in white paint, rubber, linoleum, and other materials. Barium carbonate is used as a carbon carrier in case-hardening steel, in preventing efflorescence in structural bricks, and as a starting point in making other barium compounds, including the nitrate, oxide, peroxide, and hydroxide. The nitrate is used in green signal flares and explosives, the oxide in case-hardening steel, the peroxide in making hydrogen peroxide, and the hydroxide in beet-sugar purification.

In the following table, dealing with production, use, and sales of barium chemicals by the barium-chemical industry, which first appeared in this chapter reviewing 1943, it has been decided to omit barium sulfide, virtually all of which exists only in solution, and to add black ash produced by lithopone and chemical manufacturers.

Barium chemicals produced and used or sold by producers in the United States, 1941-44, in short tons

Chemical	Plants	Produced	Used by producers in other barium chemicals ¹	Sold by producers ¹	
				Short tons	Value
Black ash:²					
1941.....	16	161,723	150,397	1,648	\$65,350
1942.....	18	163,119	163,043	950	41,276
1943.....	18	148,179	147,975	553	23,969
1944.....	17	153,624	153,573	371	16,316
Carbonate (synthetic):					
1941.....	5	21,857	5,297	16,296	724,977
1942.....	7	*30,204	*14,724	14,905	830,034
1943.....	5	*35,308	*21,513	13,979	753,832
1944.....	5	37,911	27,561	9,313	467,268
Chloride (100 percent basis):					
1941.....	3	13,873	994	12,789	1,038,322
1942.....	3	13,439	1,722	11,497	913,290
1943.....	3	15,379	5,111	10,545	942,399
1944.....	3	17,183	5,766	11,446	955,571
Dioxide:					
1941.....	2	(³)	(³)	(³)	(³)
1942.....	2	(³)	(³)	(³)	(³)
1943.....	3	4,123	*1,682	*2,495	*563,756
1944.....	2	(³)	(³)	(³)	(³)
Hydroxide:					
1941.....	4	1,695	755	1,027	119,063
1942.....	3	2,327	66	2,335	267,572
1943.....	4	2,761	54	2,715	281,138
1944.....	3	2,462	98	2,429	244,072
Nitrate:					
1941.....	3	491	-----	432	72,539
1942.....	5	11,547	-----	*11,489	*2,262,061
1943.....	5	12,157	-----	12,324	2,376,631
1944.....	3	11,160	-----	11,333	2,066,976
Oxide:					
1941.....	2	(³)	(³)	(³)	(³)
1942.....	3	3,922	3,543	155	30,732
1943.....	3	5,189	4,998	170	37,925
1944.....	3	4,748	4,638	84	19,138
Sulfate (synthetic):					
1941.....	7	25,509	15,427	11,302	668,084
1942.....	6	22,965	14,562	8,226	506,183
1943.....	7	23,811	10,628	13,646	873,312
1944.....	8	28,022	15,298	12,926	900,910
Other barium chemicals:					
1941.....	(³)	*30,460	4,782	*27,823	*3,118,841
1942.....	(³)	25,881	1,803	21,053	2,554,603
1943.....	(³)	21,399	-----	21,442	2,461,575
1944.....	(³)	28,414	2,904	25,568	3,070,027
Total:					
1941.....	*20	-----	-----	*71,319	*5,807,175
1942.....	*23	-----	-----	*70,610	*7,405,770
1943.....	*24	-----	-----	*77,869	*8,314,537
1944.....	*22	-----	-----	73,470	7,740,318

¹ Includes purchased material.

² Exclusive of purchased material and exclusive of sales by one producer to another.

³ Black-ash data include lithopone plants.

⁴ Revised figures.

⁵ Included under "Other barium chemicals."

⁶ Revised figures owing to expanded coverage.

⁷ Plants included in above figures.

⁸ A plant producing more than 1 product is counted but once in arriving at grand totals.

Lithopone¹ sold or used by producers in the United States, 1940-44

	1940	1941	1942	1943	1944
Plants.....	11	9	9	9	8
Short tons.....	151,802	176,642	137,320	135,723	142,905
Value.....	\$10,197,897	\$12,550,193	\$10,828,924	\$10,745,305	\$11,208,891

¹ Exclusive of cadmium lithopone.

Lithopone¹ sold or used by producers, 1942-44, by consuming industries

Industry	1942		1943		1944	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paints, enamels, and lacquers.....	109,216	80	103,860	76	108,800	76
Floor coverings and textiles.....	15,775	11	15,999	12	14,746	10
Rubber.....	1,047	1	1,078	1	726	1
Other.....	11,282	8	14,786	11	18,633	13
	137,320	100	135,723	100	142,905	100

¹ Exclusive of cadmium lithopone.

PRICES

Range of quotations on barium chemicals, 1942-44

	1942 ¹	1943 ¹	1944 ¹
Lithopone:			
Domestic, ordinary, delivered, bags, pound.....	\$0.04¼	\$0.04¼-\$0.04¾	\$0.04¼-\$0.04¾
Do.....barrels, do.....	.04½	.04½	.04½
Titanated, bags.....do.....	.056	.056	.056
Do.....barrels.....do.....	.0585	.0585	.0585
Barium carbonate, precipitated, 200-pound bags, works.....short ton.....	\$55.00 -65.00	55.00 -60.00	55.00 -70.00
Barium chlorate, 112-pound kegs, New York pound.....	.60	.36	.36
Barium chloride, barrels, delivered zone 1 short ton.....	77.00 -92.00	79.00 -92.00	75.00 -90.00
Barium dioxide (binoxide or peroxide) drums, works.....pound.....	.10	.10 - .13	.10 - .13
Barium hydrate, 500-pound barrels, works, do.....	.06 - .07	.06 - .07	.06 - .07
Barium nitrate, barrels.....do.....	.10¼ - .12¼	.11 - .12	.10 - .12
Blanc fixe (dry):			
Direct process, bags, c. l., f. o. b. works short ton.....	70.00	70.00	70.00
Byproduct, bags, c. l., . o. b. works.....do.....	60.00	60.00	60.00

¹ Quotations other than blanc fixe from Chemical Industries (formerly Chemical Markets), New York (monthly). Blanc fixe quotations from Oil, Paint and Drug Reporter.

² Oil, Paint and Drug Reporter.

FOREIGN TRADE

Barium chemicals imported for consumption in the United States, 1940-44

[Value at port of shipment]

Year	Lithopone		Barium dioxide		Blanc fixe (precipitated barium sulfate)		Barium chloride	
	Short tons	Value	Pounds	Value	Short tons	Value	Short tons	Value
1940.....								
1941.....	(1)	\$0	4,032	\$208	15	\$865		
1942.....			40,992	2,119	28	1,357	36	\$15,770
1943.....							18	7,885
1944.....								

Year	Barium nitrate		Barium hydroxide		Barium compounds (n. e. s.)	
	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	18	\$1,427	151	\$3,332	22	\$4,286
1941.....			292	10,791	8	4,071
1942.....	(2)	1	147	9,361	154	76,667
1943.....			151	9,850	43	15,265
1944.....			85	7,382		

1 112 pounds.

2 53 pounds.

Lithopone exported from the United States, 1940-44

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1940.....	14,298	\$1,112,362	\$77.80	1943.....	17,320	\$1,637,217	\$94.53
1941.....	21,527	2,079,229	96.59	1944.....	11,551	1,106,430	95.79
1942.....	17,036	1,733,698	101.77				

POSTWAR OUTLOOK

Well drilling has been the largest use of barite in most years since 1938 and probably will continue in this preeminent position after the war. Demand for barite in lithopone is very difficult to predict. The lithopone industry has run at capacity during the war but must eventually face competition from the more opaque titanium pigments. The lithopone industry should survive as long as titanium dioxide is sold at 15 cents a pound and lithopone at 4½ cents. The barium-chemicals industry doubtless will cease making a few items, such as the nitrate, which were used solely for military purposes, but production of the chloride, carbonate, sulfate, and hydroxide should continue in but slightly reduced volume for civilian needs. The barite supply in all parts of the country is adequate save on the Atlantic coast, where reduction of output in Tennessee has already necessitated imports. Unless new deposits are found in Tennessee and Georgia, supplementary barite must be brought into eastern markets from Nova Scotia, Germany, or Missouri. The following table compares the costs of barite from the sources mentioned.

Costs of delivering a short ton of chemical-grade barite to certain cities in the eastern United States, July 1944

[Unloading and handling charges and insurance are not included on the ocean shipments. The unloading and handling charge on Nova Scotia barite received at Baltimore is \$1.13, insurance is \$0.03, and miscellaneous \$0.35]

To—	From—				
	Cartersville, Ga.	Sweetwater, Tenn.	St. Louis, Mo.	Germany (prewar rates)	Nova Scotia
Charleston, W. Va.:					
F. o. b. origin.....	¹ \$8.93	¹ \$8.93	¹ \$8.50	\$5.30	\$6.82
Freight.....	3.93	3.54	6.20	² 11.26	³ 9.38
Duty.....				3.70	3.70
	12.86	12.47	13.70	20.26	19.90
Palmerton, Pa.:					
F. o. b. origin.....	¹ 8.93	¹ 8.93	¹ 8.50	5.30	6.82
Freight.....	5.40	4.91	5.36	⁴ 6.21	⁵ 5.07
Duty.....				3.70	3.70
	14.33	13.84	13.86	15.21	15.59
Baltimore, Md.:					
F. o. b. origin.....	¹ 8.93	¹ 8.93	¹ 8.50	5.30	6.82
Freight.....	4.32	3.83	5.36	3.86	⁶ 3.38
Duty.....				3.70	3.70
	13.25	12.76	13.86	12.86	13.90
Grasselli, N. J.:					
F. o. b. origin.....	¹ 8.93	¹ 8.93	¹ 8.50	5.30	6.82
Freight.....	5.89	5.22	6.38	3.86	⁷ 2.72
Duty.....				3.70	3.70
	14.82	14.15	14.88	12.86	13.24
Newport, Del.:					
F. o. b. origin.....	¹ 8.93	¹ 8.93	¹ 8.50	5.30	6.82
Freight.....	4.50	4.42	5.36	3.86	⁷ 3.38
Duty.....				3.70	3.70
	13.43	13.35	13.86	12.86	13.90

¹ Cheapest ceiling rate. In Georgia and Tennessee considerable barite was also sold at ceilings of \$9.38 and \$9.82.

² Ocean rate is \$3.86; nominal freight Baltimore to Charleston is \$6.00.

³ Ocean rate is \$3.38; freight Baltimore to Charleston is \$6.

⁴ Ocean rate is \$3.86; freight New York to Palmerton is \$2.35.

⁵ Ocean rate, full cargo, \$2.72 including 13-percent surcharge; freight New York to Palmerton is \$2.35.

⁶ Full cargo rate; includes 22-percent surcharge.

⁷ Full cargo rate; includes 13-percent surcharge.

POTASH

By BERTRAND L. JOHNSON AND DOROTHY I. MARSH

SUMMARY OUTLINE

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GENERAL CONDITIONS

New records have been made in the annual production and sales of domestic potassium salts. In 1944, 1,578,498 short tons of marketable

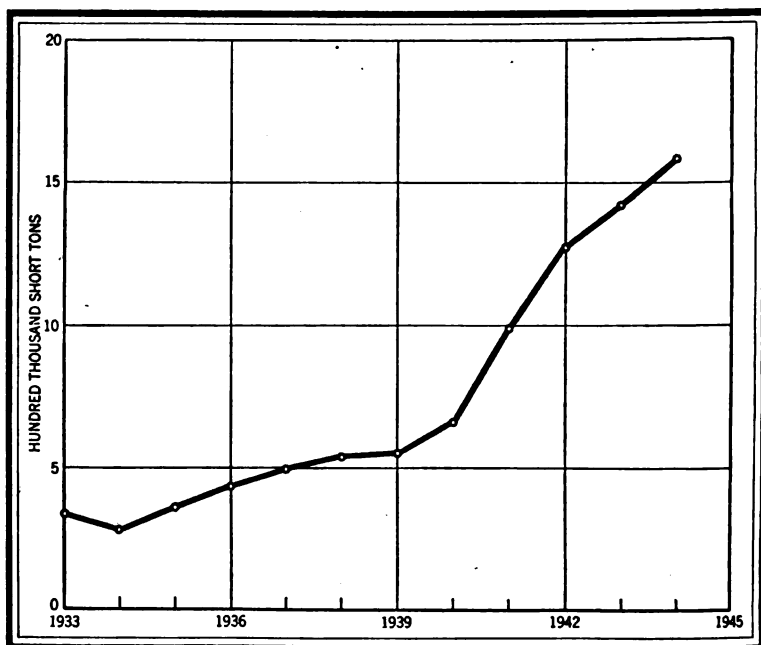


FIGURE 1.—Production of marketable potassium salts in the United States, 1933-44.

potassium salts containing 834,568 tons of equivalent potash (K_2O) were produced. (See fig. 1.) A somewhat smaller quantity (1,543,420 tons), likewise a record, was sold; according to the producers, this material contained 817,892 tons of equivalent potash. Stocks of potassium salts, in terms of K_2O in producers' hands at the end of 1944, were more than double those of 1943 and larger than in any recent year. Exports of both fertilizer and chemical potash were less in 1944 than in 1943. Imports of potash for fertilizer purposes were much less than in 1943, but those for chemical use were larger. Domestic consumption of potash made a new record—about 753,000 short tons of K_2O .

A general summary, by Turrentine,¹ of the American potash industry under wartime conditions, appeared late in 1944.

¹ Turrentine, J. W., The American Potash Industry Meets Its Wartime Test: Chem. and Eng. News, vol. 22, No. 22, Nov. 25, 1944, pp. 1994-1998.

Salient statistics of the potash industry in the United States, 1942-44

	1942	1943	1944
Production:			
Potassium salts (marketable).....short tons..	1,267,455	1,428,840	1,578,498
Approximate equivalent, K_2O do.....	679,206	739,141	834,568
Sales by producers:			
Potassium salts.....do.....	1,277,317	1,401,271	1,543,420
Approximate equivalent, K_2O do.....	680,831	732,151	817,892
Value at plant.....do.....	\$22,962,518	\$26,185,073	\$29,487,413
Average per ton.....do.....	\$17.98	\$18.69	\$19.11
Imports:			
Fertilizer materials.....short tons..	15,895	45,009	13,739
Approximate equivalent, K_2O do.....	2,915	17,005	3,780
Value.....do.....	\$418,787	\$1,287,022	\$397,575
Chemical materials.....short tons..	5,433	419	5,402
Approximate equivalent, K_2O do.....	1,444	104	1,108
Value.....do.....	\$1,784,671	\$156,097	\$1,650,776
Exports:			
Fertilizer materials.....short tons..	84,402	111,541	110,057
Approximate equivalent, K_2O do.....	42,600	60,142	61,312
Value.....do.....	\$2,184,044	\$3,168,446	\$3,139,851
Chemical materials.....short tons..	13,307	20,133	15,419
Approximate equivalent, K_2O do.....	6,520	9,865	7,555
Value.....do.....	\$3,611,656	\$3,950,542	\$3,098,565
Consumption:			
Apparent consumption: ¹			
Potassium salts.....short tons..	1,200,936	1,315,025	1,437,085
Approximate equivalent, K_2O do.....	636,070	679,253	753,893
Actual sales for consumption:			
Approximate equivalent, K_2O do.....	635,408	² 678,131	752,332

¹ Estimate by Bureau of Mines.² Quantity sold by producers, plus imports, minus exports.³ Revised figure.

Potash Allocation Order M-291, which was to have expired May 31, 1944, was amended April 3, 1944, and extended for another 12 months. Effective March 22, 1945, all primary potash salts (muriate of potash, sulfate of potash, sulfate of potash-magnesia, and run-of-mine potash) were removed from Allocation Order M-291 and placed under General Chemicals Order M-300.

POSTWAR OUTLOOK

The present domestic potash mines can produce more than normal domestic requirements under peace time conditions. Availability of foreign supplies after the war will limit foreign markets for American potash, and certain of these potash-producing nations may enter the domestic market in competition with American companies, especially if it is considered advisable to restrict domestic production to conserve our known potash resources. The enlarged food-production programs probably will maintain domestic potash output at high levels for some time.

DOMESTIC RESERVES

The domestic potash industry is based largely upon the sylvite (KCl) deposits of the Carlsbad (N.Mex.) region; the potassium-bearing brines of Searles Lake, Calif., and Salduro Marsh, Utah; and the langbeinite ($K_2SO_4 \cdot 2 MgSO_4$) deposits of the Carlsbad region. Estimates made about 1940 placed the total known resources of water-soluble potash in the above deposits at around 90 million tons K_2O , adequate for only about 100 years at the present rate of consumption. Even on the basis of these early estimates the Committee on National Fertilizers and Lime Policy urges ² that greatly intensified efforts be made by the Federal Government to discover new domestic sources of

² Committee on National Fertilizers and Lime Policy, U. S. Department of Agriculture and War Food Administration, A National Policy for Fertilizers and Liming Materials: Washington, D. C., February 1945, 11 pp.

water-soluble potash on public land; that, until vastly larger deposits are discovered, our limited known resources be looked upon as a strategic reserve; and that, if extensive new deposits are not located soon, further vigorous steps be taken to curtail the use of American deposits and replace them with imports.

Most of the known domestic potash reserves are in the Texas-New Mexico field. According to estimates made in 1940 these beds contain 75,000,000 tons K_2O . Such estimates were based on beds of potash salts 4 feet or more in thickness which analyze at least 14 percent K_2O . Mansfield and Lang,³ after calling attention to the fairly wide distribution of sylvite in this field, state that:

The richer sylvite beds are localized in four known minor areas which have been prospected in some detail and which are surrounded by barren or relatively barren ground. Such prospecting as has been done outside of these areas has not thus far led to any very encouraging results, but it is quite possible that other rich localities may be discovered. . . .

Three of these known areas are now being mined, and the fourth was prospected by the Government in 1944. The reserves in the areas now producing are being rapidly exhausted. A recent article⁴ states that:

Apparently the four major companies [three of which are in the New Mexico field] can continue for perhaps 10 to 15 years at present rates without exhausting the reserves to which they have acquired rights.

The rights referred to were acquired before the new regulations promulgated by the United States Department of the Interior in January 1945. The Government drilling in the fourth area in the Carlsbad region proved up only a few million tons of K_2O . The known economically recoverable potash reserves in this field therefore appear quite limited.

With reference to national security, even in the near future, further search for deposits of soluble potash is urgently needed. Probable areas where such deposits might be found include the Texas-New Mexico field, the Grand County (Utah) field, and eastern United States. Possibilities are definitely known in the first two fields. The salt deposits of eastern United States have never been tested for potash beds by core drilling, although well brines show significant quantities of potash, and salt beds containing 8 percent KCl have been found in Nova Scotia, northeast of this area.

PRODUCTION AND SALES

The annual increase in production of marketable potassium salts in the United States since 1934 was once more evident in 1944. Again it was large, 149,658 tons more being produced in 1944 than in 1943, and the approximate equivalent K_2O content of the production was 95,427 tons greater. Sales exceeded a million and a half (1,543,420) tons in 1944 and were a little more than 10 percent over those in 1943. The contained equivalent potash (K_2O) was 817,892 tons, an increase of nearly 12 percent over 1943. Production exceeded sales; producers' stocks were again larger at the end of the year than at the beginning and larger than in several recent years. The average value of the potassium salts sold in 1944 was \$19.11 per ton.

³ Mansfield, G. R., and Lang, W. B., The Texas-New Mexico Potash Deposits: Univ. Texas Bull. 3401, 1935, pp. 641-832. (See p. 682.)

⁴ McBride, R. S., Wootton, Paul, and Burton, Malcolm, Watching Washington: Chem. and Met. Eng. vol. 52, No. 3, March 1945, p. 82.

Production of all types of marketable potassium salts listed in the following table, except manure salts, was larger in 1944 than in 1943.

Potassium salts produced in the United States, 1942-44, by grades, in short tons

Grade	1942	1943	1944
Muriate of potash:			
60-62 percent K_2O minimum ¹	878,997	934,961	1,082,132
48-50 percent K_2O minimum.....	85,680	99,137	114,550
Manure salts, run-of-mine.....	183,404	242,189	217,590
Sulfate of potash and sulfate of potash-magnesia.....	119,374	152,553	164,256
	1,267,455	1,428,840	1,578,498

¹ Includes refined potash.

The potash industry retains its western character. Virtually all the 1944 output came from California, New Mexico, and Utah, largely from the deeply buried Permian saline sedimentary deposits of New Mexico. Only a small quantity (a byproduct of cement operations in Maryland) came from the Eastern States. The domestic potash salts sold in 1944 were largely refined or processed products.

The potash-producing companies in the United States in 1944, by States, were as follows:

California:

The American Potash & Chemical Corp., 122 East Forty-second Street, New York City (plant at Trona, on Searles Lake, Calif.).

Maryland:

North American Cement Corp., 41 East Forty-second Street, New York City (plant at Security, Md.).

New Mexico:

International Minerals & Chemical Corp., 20 North Wacker Drive, Chicago, Ill. (mine and plant near Carlsbad, N. Mex.).

Potash Company of America, Carlsbad, N. Mex. (mine and plant near Carlsbad, N. Mex.).

United States Potash Co., Inc., 30 Rockefeller Plaza, New York City (mine and plant near Carlsbad, N. Mex.).

Utah:

Bonneville, Ltd., 540 West Seventh South, Salt Lake City, Utah (plant near Wendover, Utah).

Potassium salts produced, sold, and in producers' stocks in the United States, 1940-44

Year	Production			Sales				Producers' stocks		
	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Value f. o. b. plant	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)
1940.....	7	658,249	379,679	7	677,892	393,058	\$12,562,050	7	35,060	16,370
1941.....	7	966,458	524,875	7	994,843	531,346	17,368,237	7	26,374	9,712
1942.....	7	1,267,455	679,206	7	1,277,317	680,831	22,962,518	7	14,158	6,041
1943.....	7	1,428,840	739,141	7	1,401,271	732,151	26,183,073	7	43,691	13,984
1944.....	6	1,578,498	834,568	6	1,543,420	817,892	29,487,413	6	76,123	29,763

CONSUMPTION

Consumption of potash salts in the United States and its possessions in 1944 was approximately 753,000 tons of K_2O . The following table, based largely upon deliveries of potash of domestic origin as reported by the American Potash Institute, indicates actual sales of 752,332 tons for domestic consumption in the United States. Apparent consumption, calculated by subtracting exports from the

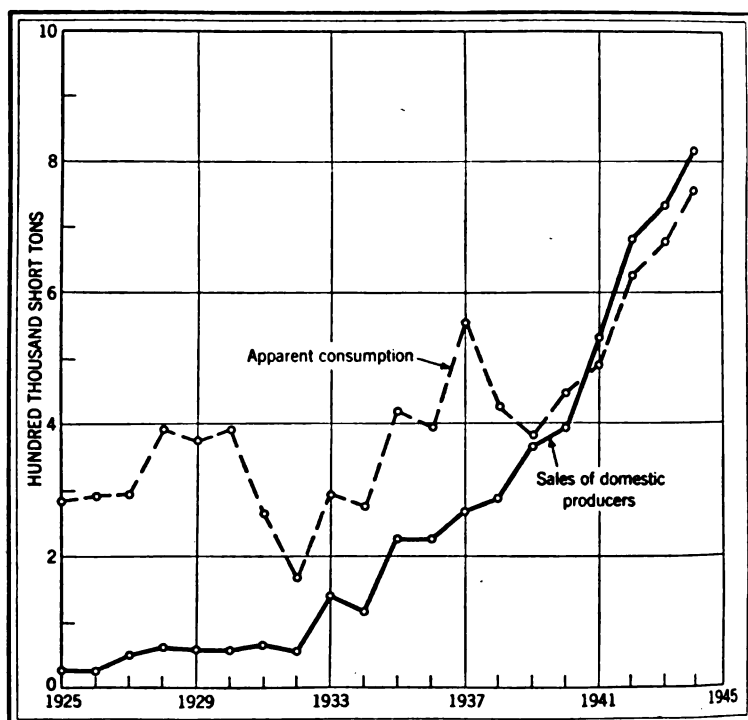


FIGURE 2.—Comparison of apparent domestic consumption of potash (K_2O) and sales by domestic producers of potash in the United States, 1925-44.

sum of the imports and producers' sales, was 753,893 tons of K_2O in 1944.

Apparent domestic consumption of potassium salts, in terms of equivalent potash (K_2O), and its relationships to sales of domestic producers, as reported to the Bureau of Mines for a period of years, are shown in figure 2.

According to figures of the American Potash Institute on potash deliveries, 89 percent of the domestic deliveries of American potash in 1944 went to the fertilizer industry and 11 percent for chemicals.

Sales of potash in the United States for consumption and export, 1942-44, in short tons of K_2O

	1942	1943	1944
Deliveries of primary potash of domestic origin by major companies, as from reports of American Potash Institute—			
In United States and possessions:			
Agricultural.....	558,356	¹ 590,733	675,787
Chemical.....	63,388	¹ 84,367	82,198
For export.....	38,504	¹ 55,261	57,850
Imports for consumption plus sales of minor domestic producers.....	660,248	¹ 730,361	815,835
	24,280	¹ 17,777	5,364
Total exports (estimate by Bureau of Mines).....	684,528	¹ 748,138	821,199
	49,120	70,007	68,867
Actual sales for consumption in the United States.....	635,408	¹ 678,131	752,332

¹ Revised figures.

PRICES

Price lists for the 1944-45 fertilizer season were released by the major potash companies on dates ranging from April 1 to May 15, 1944. Most of the schedules covered the period from June 1, 1944, to May 31, 1945. The following base prices were reported by the various producing companies:

Muriate of potash (62 to 63 percent; 62 percent K_2O minimum).	53½ cents per unit K_2O .
Muriate of potash (60 percent K_2O minimum).	53½ cents per unit K_2O .
Muriate of potash, granular (50 percent K_2O minimum).	53½ cents per unit K_2O and in the first issued schedule 56 cents per unit K_2O (later reduced to 53½ cents).
Muriate of potash, granular (48 to 52 percent, 48 percent K_2O minimum).	53½ cents per unit K_2O .
Manure salts:	
22 to 26 percent K_2O , 22 percent K_2O minimum, run-of-mine.	20 cents per unit K_2O .
22 percent K_2O minimum.	20 cents per unit K_2O .
Sulfate of potash (90 to 95 percent K_2SO_4 , basis 90 percent K_2SO_4).	\$36.25 per short ton.
Sulfate of potash-magnesia (basis 40 percent K_2SO_4 , 18.50 percent MgO).	\$26.00 per short ton.

Maximum Price Regulation 404—Potash, effective June 18, 1943, providing for maximum prices of potash, was in effect until July 5, 1944, when it was superseded by Revised Maximum Price Regulation 205 (Fertilizer Raw Materials) of June 30, 1944. Muriate of potash, manure salts, sulfate of potash, and sulfate of potash-magnesia were covered in the new regulations, as in the old. No changes were made in the base prices.

Retail prices of potash were covered during 1944 by Second Revised Maximum Price Regulation 135 of November 17, 1943; Second Revised Maximum Price Regulation 135, Including Amendment 1, of January 5, 1944; and Second Revised Maximum Price Regulation 135 as amended July 26, 1944.

REVIEW BY STATES

General.—In 1944 merchantable potash salts were produced in four States—California, Maryland, New Mexico, and Utah. The output of the States (except New Mexico, where there were three companies) cannot be given separately without disclosing individual company returns. New Mexico was by far the largest domestic producer, furnishing 85 percent of the total. California, although a much smaller producer than New Mexico, furnished considerably more than the combined output of the other two States.

A program for converting potassium chloride to potassium sulfate was initiated by the Government in November 1944 to supplement the supply of potassium sulfate, particularly in tobacco-producing areas. Potassium chloride was to be substituted for sodium chloride in the production of hydrochloric acid at the Rubber Reserve Co. plant at Louisville, Ky. The plan was abandoned, however, shortly after the start of operations, because of a break-down of the acid-producing facilities.

Discovery of metals of the platinum group in western alunites has been reported.⁵ Traces of platinum metals are said to have been

⁵ Cress, S. H., and Feldman, Cyrus, *Platinum Minerals Identified in Western Alunite*: Eng. and Min. Jour., vol. 144, No. 12, 1943, p. 106.

identified in alunite samples from Sugar Loaf Peak, Yuma County, Ariz., and Marble Mountain, Rio Grande County, Colo. Traces of rubidium are also reported in a few samples and traces of gallium in nearly all samples examined.

California.—The American Potash & Chemical Corp. (122 East Forty-second Street, New York City), only producer of potash in California, is reported to have enlarged its plant at Searles Lake and to have improved the refining process. Descriptions of the operations have appeared in two articles⁶ and in a large, illustrated booklet issued by the company. The stock of the company remained vested in the hands of the Alien Property Custodian, although rumors of a proposed offering of the stock for sale appeared in financial journals about midyear.

Since January 1944 the Western Electrochemical Co. has been producing potassium perchlorate in Los Angeles. Descriptions of the plant appeared late in the year.⁷

Maryland.—Only one company in Maryland produced byproduct potash for agricultural use in 1944. This was the North American Cement Corp. (41 East Forty-second Street, New York City) which at its plant at Security, Washington County, a short distance east of Hagerstown, recovered impure sulfate of potash from cement-kiln flue dust.

New Mexico.—Mine production of potash salts in the Carlsbad region of New Mexico continued to increase in 1944, and another record was made. The three companies operating in this area mined 3,749,250 tons of sylvinite and crude langbeinite combined—316,007 tons more than in 1943. The average equivalent K_2O content of the mined salts increased from 21.19 percent in 1943 to 21.33 percent in 1944. The average equivalent K_2O content of the sylvinite mined was 22.9 percent in 1941, 22.7 percent in 1942, 22.6 percent in 1943, and 22.7 percent in 1944.

All three companies mined sylvite (potassium chloride) and one—the International Minerals & Chemical Corp.—mined also langbeinite (a potassium-magnesium sulfate). The greater part of the mined production was sylvite, most of which was processed to yield 60-percent or higher-grade K_2O muriate. The production of merchantable potash salts in New Mexico in 1944 was 1,337,459 tons (85 percent of the total domestic production), with an equivalent K_2O content of 694,872 tons (83 percent of the total production). Sales were 1,304,497 tons (85 percent of the United States total), with an equivalent K_2O content of 679,721 tons (83 percent of the domestic total) and valued at \$24,739,507. Muriate of potash was produced by all three companies. Potassium sulfate and potassium-magnesium sulfate (sulfate of potash-magnesia) were produced from crude langbeinite by the International Minerals & Chemical Corp. in the refinery at its mine near Carlsbad. Potassium sulfate was produced also by the Potash Company of America.

The abundance of magnesium in 1944 brought about the closing of the magnesium-metal plant at Austin, Tex., in that year; as a result,

⁶ The Dupont Magazine, Potash and a Briny Desert Deep: Vol. 38, No. 3, June-July-August, 1944, p. 16. Tucker, W. B., and Sampson, R. J., Mineral Resources of San Bernardino County: California Jour. Mines and Geol., vol. 39, No. 4, October 1943, pp. 427-549. (See p. 537.)

⁷ Schumacher, J. C., Continuous Electrolytic Process for Perchlorate: Chem. and Met. Eng., vol. 51, No. 12, December 1944, pp. 108-109.

Chemical and Metallurgical Engineering, Potassium Perchlorate: Vol. 51, No. 12, December 1944, pp. 130-133.

the Defense Plant Corporation found it unnecessary to continue its production of magnesium-chloride cell feed for the Austin plant from potash salts at its Carlsbad (N. Mex.) plant, adjacent to the refinery of the International Minerals & Chemical Corp., and operations there were stopped in May 1944, after that plant had been in operation about 11 months. Detailed descriptions of this magnesium chloride plant have been published.⁸

In February 1944 the United States Department of the Interior obtained bids for drilling on, and in the vicinity of, the Potash Reserve established in the Carlsbad region by Executive order in 1931. To determine the extent and richness of this particular deposit, 16 core holes were drilled by the Bureau of Mines in cooperation with the Geological Survey. Drilling was begun about March 1, 1944, and work on the project was completed in October 1944. A few million tons of possible profitably minable potash salts, containing over 20 percent K_2O , were disclosed by the drilling operations.

Following the suggestion of A. D. Mackay of New York that cesium or rubidium might be found associated with the langbeinite of the Carlsbad area, spectrographic analyses for these elements were made by the Eastern Experiment Station of the Bureau of Mines on specimens of carnallite, langbeinite, and sylvite from that area. Rubidium was found in all three minerals. The largest quantity, around 0.5 percent of rubidium oxide, appeared in the carnallite. Cesium was found in the sylvite alone and only in traces. Further studies of the occurrence of these two elements in this field are needed to determine whether, in the processes now in use or in future technology, they could be recovered profitably. In the Stassfurt region, Germany, the carnallites contain only small percentages of cesium and rubidium, but these deposits are important sources of the metals because their salts become concentrated in the large-scale extraction of potassium chloride.

The geology of the potash-bearing area was discussed by Adams⁹ in an article published late in 1944. The use of shuttle cars in the mine of the International Minerals & Chemical Corp. was described by Harley¹⁰ and in that of the Potash Company of America by Haworth.¹¹

The commercial possibilities and technology of the Texas-New Mexico polyhalite deposits are discussed by Conley and Partridge in a Bureau of Mines bulletin issued in 1944.¹²

Utah.—Of the several types of potash occurrences in Utah, only the potassium-bearing brines were in commercial production in 1944. Bonneville, Ltd. (Salt Lake City) continued to produce potassium chloride from Salduro Marsh brines at its plant near Wendover, Tooele County, in northwestern Utah. Production was much above

⁸ Manning, P. D. V., and Kirkpatrick, S. D., Better Utilization of Mineral Resources Through Chemical Technology: Chem. and Met. Eng., vol. 51, No. 5, May 1944, pp. 92-96.
⁹ Chemical and Metallurgical Engineering, Magnesium from Minerals: Vol. 51, No. 5, May 1944, pp. 142-145.

¹⁰ Engineering and Mining Journal, Magnesium Metal from Carlsbad Potash: Vol. 145, No. 8, August 1944, pp. 70-75.

¹¹ Adams, J. E., Upper Permian Ochoa Series of Delaware Basin, West Texas and Southeastern New Mexico: Bull. Am. Assoc. Petrol. Geol., vol. 28, No. 11, November 1944, pp. 1596-1625.

¹² Harley, G. T., Three Years of Shuttle Cars at International's Potash Mine: Eng. and Min. Jour., vol. 145, No. 5, May 1944, pp. 62-65.

¹³ Haworth, R. G., Potash Company of America Uses Battery Shuttle Cars: Eng. and Min. Jour., vol. 145, No. 5, May 1944, pp. 65-67.

¹⁴ Conley, J. E., and Partridge, E. P., Potash Salts from Texas-New Mexico Polyhalite Deposits; Commercial Possibilities, Proposed Technology, and Pertinent Salt-Solution Equilibria: Bureau of Mines Bull. 459, 1944, 251 pp.

that in 1943 and even exceeded the previous peak of 1942. A detailed description of the operations was published near the end of the year.¹³

Some development work was carried on in 1944 on the alunite deposits of the Marysville district, Piute County. The Bureau of Mines began operations in May and completed its exploratory work late in October. The earlier work, consisting of surface trenching, diamond drilling, and sampling, was on the White Hills claims. Later, trenching and sampling were done on some of the other claims. Kalunite, Inc. (Box 238, Salt Lake City), did no mining at its Empico (White Horse) mine at Marysville but shipped crude alunite from stock at the mine to its Salt Lake City alumina plant, where it was milled. The Salt Lake City plant was operated only on an experimental basis, production being used in building up the circuit. There were no sales of the products. A description of the plant by the technical director, Arthur Fleischer, was published during the year.¹⁴

No development work is known to have taken place in 1944 in the Grand County potash field in eastern Utah. In February 1944 B. W. Dyer¹⁵ presented a paper before the New York meeting of the American Institute of Mining and Metallurgical Engineers describing the results of drilling operations in the Crescent Eagle, Salt Valley, Seven Mile, Cane Creek, and Salt Wash areas in eastern Utah.

Public Land Order 130, issued May 26, 1943, which temporarily, withdrew and reserved certain public lands in Utah, therein described, for classification and for prospecting and development under the mineral leasing laws, was revoked by Secretary of the Interior Harold L. Ickes on January 4, 1945, in Public Land Order 256. Subject to valid existing rights, the public lands contained in certain specified areas totaling approximately 210,650 acres, were withdrawn from all forms of appropriation under the public lands laws, including the mining and mineral-leasing laws, and reserved for classification under the jurisdiction of the Secretary of the Interior.

FOREIGN TRADE¹⁶

Imports.—With the continuance of World War activities, imports of potash salts in 1944 remained at the recent low levels, a total of only 19,141 short tons (4,868 tons K_2O) being imported. The total value of imports, however, jumped to \$2,048,351 because of the importation of considerable quantities of high-valued argols and cream of tartar. Chile, U. S. S. R., Algeria, and Argentina were the principal sources of imports.

Potash (K_2O) for fertilizer use constituted only 77.2 percent of the total imports in 1944, whereas in 1943, with the decline in bitartrate imports, fertilizers had formed 99.4 percent of the total. Imports for chemical use rose in 1944 to 22.8 percent of the total, largely because of the increased argols imports.

Potassium-sodium nitrate (Chile) was the principal potash salt imported in 1944 for fertilizer use—9,407 tons (1,317 tons K_2O) out of the total of 13,739 tons of fertilizer salts (3,760 tons K_2O) imported.

¹³ Smith, H. R., Utah Desert Yields Potassium Chloride for Western Agriculture: Chem. and Met. Eng., vol. 51, No. 12, December 1944, pp. 94-95.

¹⁴ Fleischer, Arthur, The Kalunite Process: Am. Inst. Min. and Met. Eng., Tech. Pub. 1713, 1944, 13 pp.; bound in Metals Technol., August 1944.

¹⁵ Dyer, B. W., Discoveries of Potash in Eastern Utah: Am. Inst. Min. and Met. Eng., Tech. Pub. 1735, 1945, 6 pp.; bound in Min. Technol., January 1945.

¹⁶ Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Potash materials imported for consumption in the United States, 1943-44

Material	Approximate equivalent as potash (K ₂ O) (percent)	1943				1944			
		Short tons	Approximate equivalent as potash (K ₂ O)		Value	Short tons	Approximate equivalent as potash (K ₂ O)		Value
			Short tons	Percent of total			Short tons	Percent of total	
Used chiefly in fertilizers:									
Muriate (chloride).....	56.4	25,212	14,220	83.1	\$705,602	4,332	2,443	50.2	\$119,041
Potassium-sodium nitrate mixtures, crude.....	14.0	19,767	2,767	16.2	580,760	9,407	1,817	27.0	278,534
Other potash fertilizer material ¹	60.0	30	18	.1	660	-----	-----	-----	-----
Total fertilizer.....		45,009	17,005	99.4	1,287,022	13,739	3,760	77.2	397,575
Used chiefly in chemical industries:									
Bitartrate:									
Argols.....	20.0	319	64	.6	105,505	5,061	1,012	22.8	1,417,464
Cream of tartar.....	25.0	4	1		3,647	261	65		199,455
Chlorate and perchlorate.....	36.0	66	24		26,226	61	22		17,332
Ferrieyanide (red prussiate).....	42.0	-----	-----		-----	1	(?)		1,433
All other.....	50.0	30	15		21,719	18	9		15,092
Total chemical.....		419	104	.6	156,097	5,402	1,108	22.8	1,650,776
Grand total.....		45,428	17,109	100.0	1,443,119	19,141	4,868	100.0	2,048,351

¹ Chiefly wood ashes from Canada. ² Less than 1 ton.*Potash materials imported for consumption in the United States, 1943-44, by countries, in short tons*[Figures in parentheses in column headings indicate, in percent, approximate equivalent as potash (K₂O)]

Country	Muriate (chloride)	Bitartrate		Potas- sium sodium nitrate mixtures, crude	Chlo- rate and per- chlo- rate	All other ¹	Total	
		Argols or wine lees	Cream of tartar				Short tons	Value
	(56.4)	(20)	(25)	(14)	(36)			
1943								
Argentina.....		183					183	\$45,622
Canada.....	(²)	2	4		55	33	94	28,931
Chile.....				19,767			19,767	580,760
China.....					(²)		(²)	405
Morocco, French.....		79					79	22,850
Portugal.....		55					55	15,673
Switzerland.....					11		11	1,912
U. S. S. R.....	25,212						25,212	705,599
United Kingdom ²						27	27	21,367
	25,212	319	4	19,767	66	60	45,428	1,443,119
1944								
Algeria.....		3,223					3,223	858,956
Argentina.....		999					999	281,114
Canada.....	1	2	3		61	2	69	23,973
Chile.....		32		9,407			9,439	289,831
Italy.....		119					119	29,101
Mexico.....		26					26	692
Portugal.....		513					513	178,237
Spain.....		110	258				368	234,863
U. S. S. R.....	4,331						4,331	118,998
United Kingdom ²						17	17	15,610
Uruguay.....		37					37	16,976
	4,332	5,061	261	9,407	61	19	19,141	2,048,351

¹ Approximate equivalent as potash (K₂O)-1943: 55 percent; 1944: 40 percent. ² Less than 1 ton.² United Kingdom of Great Britain and Northern Ireland.

Imports of potassium chloride (muriate) in 1944 were almost entirely from the U. S. S. R. Imports of potassium-bearing materials for consumption in the chemical industries consisted largely of potassium bitartrate as argols and cream of tartar from numerous countries but principally Algeria, Argentina, and Portugal.

Exports.—The total value of the domestic export trade in potash materials fell from over 7 million dollars in 1943 to \$6,238,416 in 1944, declines being registered in the values of both fertilizer and chemical exports; the decrease, however, was mostly in the value of the chemical materials. The total quantity of fertilizer potash materials exported in 1944—110,057 short tons—was only slightly less than in 1943; the total value still exceeded 3 million dollars. The fertilizer exports went largely to Canada (85,215 tons), with smaller amounts to other countries. Exports of chemical potash materials totaled only 15,419 tons, with a value just over 3 million dollars. The principal potash materials exported were the hydroxide (caustic potash), nitrate and mixtures, chlorate and mixtures, and the carbonate and mixtures. The United Kingdom, Canada, Brazil, and U. S. S. R., in the order named, were the leading recipients of the potash chemicals exported in 1944.

Potash materials exported from the United States, 1940-44

Year	Fertilizer		Chemical		Year	Fertilizer		Chemical	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1940	93,060	\$3,141,176	14,180	\$3,096,909	1943	111,541	\$3,168,446	20,133	\$3,890,542
1941	91,950	2,592,697	12,883	2,972,137	1944	110,057	3,139,851	15,419	3,098,565
1942	84,402	2,184,044	13,307	3,611,656					

Potash materials exported from the United States, 1943-44, by countries

Country	Fertilizers				Chemicals			
	1943		1944		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Algeria					108	\$25,702	393	\$101,391
Argentina	2	\$406	(1)	\$65	177	49,492	167	27,718
Australia	36	8,063			337	83,152	518	96,591
Barbados	1,414	62,441	5,163	178,107				
Belgian Congo	3	177			59	17,555	174	47,945
Brazil	695	31,293	1,517	60,925	1,518	287,206	2,301	500,852
Canada	74,698	1,907,758	85,215	2,280,190	3,279	593,802	3,057	461,977
Chile	(1)	12	(1)	8	335	98,976	213	65,851
Colombia	936	37,268	406	15,761	373	144,036	332	87,923
Costa Rica	(1)	24	450	17,054	39	19,269	38	14,420
Cuba	4,396	147,609	5,958	201,743	142	71,716	150	70,087
Egypt			(1)	42	155	58,786	152	49,924
Iceland	260	8,573	220	8,070	36	9,195	24	4,969
India and Dependencies	(1)	12			191	84,818	256	90,871
Iran					127	51,756	180	50,762
Mexico	1,302	15,043	564	18,232	1,058	283,356	906	217,498
Morocco, French					78	11,106	98	17,067
New Zealand	838	40,430	4,072	124,296	353	57,384	38	7,680
Union of South Africa	92	5,572	111	6,560	321	112,732	270	77,473
U. S. S. R.	145	40,496			3,329	664,222	1,568	328,960
United Kingdom	26,591	853,846	4,672	153,729	7,213	875,786	3,953	548,072
Uruguay					78	18,494	54	16,365
Venezuela	103	5,581	72	3,175	113	52,639	93	27,293
Other countries	30	3,842	1,637	71,894	714	279,362	484	186,876
	111,541	3,168,446	110,057	3,139,851	20,133	3,950,542	15,419	3,098,565

¹ Less than 1 ton. ² United Kingdom of Great Britain and Northern Ireland.

Potash materials exported from the United States in 1944, by countries and classes, in short tons

Country	Fertilizers				
	Chloride	Sulfate	Potassic fertilizer material ¹	Other ²	Total fertilizers
Barbados.....	5, 163				5, 163
Brazil.....	1, 213	304			1, 517
Canada.....	65, 351	6, 981	90	12, 793	85, 215
Colombia.....	150	256			406
Costa Rica.....	350	100			450
Cuba.....	4, 141	1, 517		300	5, 958
Iceland.....	220				220
Mexico.....	163	(³)		401	564
New Zealand.....	3, 822	250			4, 072
Union of South Africa.....	10	101			111
United Kingdom ⁴	4, 672				4, 672
Venezuela.....	67	5			72
Other countries.....	1, 611	26			1, 637
Total: Short tons.....	86, 933	9, 540	90	13, 494	110, 057
Value.....	\$2, 601, 239	\$354, 338	\$1, 954	\$182, 320	\$3, 139, 851

Country	Chemicals							
	Potas- sium io- dides	Bichro- mate and chro- mate	Hydrox- ide (caustic potash)	Acetate and mix- tures	Bicar- bonate and mix- tures	Carbon- ate and mix- tures	Bitar- trate and mix- tures	Chlo- rate and mix- tures
Algeria.....		3	11		1	2		50
Argentina.....	1		130		(³)	(³)	(³)	
Australia.....	3		234			242		
Belgian Congo.....	(³)	(³)	7				(³)	(³)
Brazil.....	7	40	231	1	1	156		400
Canada.....	2	75	1, 320	25	8	156	36	
Chile.....	(³)	10	36	(³)	(³)	15	(³)	87
Colombia.....	2	1	16	(³)	(³)	4	4	53
Costa Rica.....	(³)	2	2	(³)	(³)	(³)	2	12
Cuba.....	2	2	22	(³)	(³)	5	21	67
Egypt.....	1	16	35	(³)		10	(³)	86
Iceland.....	(³)	(³)	15			1		
India and Dependencies.....	(³)	(³)	69		1		(³)	110
Iran.....			3				2	72
Mexico.....	2	2	84	(³)	6	40	2	462
Morocco, French.....			72			1		12
New Zealand.....			26		(³)	11	1	(³)
Union of South Africa.....	1	1	131	(³)	(³)	32	(³)	54
U. S. S. R.....		432	147		42	616		122
United Kingdom ⁴			3, 953					
Uruguay.....	1	7	15			21	(³)	1
Venezuela.....	1	1	19	(³)	(³)	23	3	4
Other countries.....	15	28	109			30	9	93
Total: Short tons.....	38	620	6, 687	26	59	1, 365	80	1, 675
Value.....	\$110, 278	\$134, 651	\$951, 560	\$2, 259	\$15, 189	\$190, 442	\$101, 121	\$476, 278

See footnotes at end of table.

Potash materials exported from the United States in 1944, by countries and classes, in short tons—Continued

Country	Chemicals—Continued							Total chemicals
	Chromium sulfate (chrome alum)	Cyanide and mixtures	Nitrate and mixtures	Perchlorate and mixtures	Permanganate and mixtures	Rochelle salts	Other	
Algeria.....	1	(¹)	—	—	1	—	224	223
Argentina.....	—	5	13	—	2	(¹)	16	167
Australia.....	12	—	—	—	24	—	3	518
Belgian Congo.....	—	—	—	—	1	(¹)	166	174
Brazil.....	7	76	1,297	—	18	1	66	2,301
Canada.....	7	14	1,163	1	16	(¹)	224	3,057
Chile.....	2	2	1	—	1	(¹)	59	213
Colombia.....	(¹)	8	234	—	2	(¹)	8	332
Costa Rica.....	8	(¹)	10	—	(¹)	(¹)	2	28
Cuba.....	1	2	15	—	2	3	8	150
Egypt.....	—	2	(¹)	—	1	—	1	152
Iceland.....	—	(¹)	6	—	1	—	1	24
India and Dependencies.....	3	53	(¹)	—	(¹)	(¹)	20	256
Iran.....	3	—	—	—	—	—	100	180
Mexico.....	4	13	271	(¹)	11	3	16	906
Morocco, French.....	—	1	3	—	5	—	4	96
New Zealand.....	—	—	(¹)	—	(¹)	—	(¹)	38
Union of South Africa.....	1	1	14	—	15	1	19	270
U. S. S. R.....	—	9	104	—	80	—	16	1,568
United Kingdom ⁴	—	—	—	—	—	—	(¹)	2,953
Uruguay.....	—	3	4	(¹)	1	(¹)	1	54
Venezuela.....	1	1	36	—	1	2	1	93
Other countries.....	8	6	142	—	9	3	32	484
Total: Short tons.....	58	196	3,313	1	191	13	1,097	15,419
Value.....	\$19,189	\$106,245	\$507,957	\$2,013	\$93,731	\$13,526	\$374,126	\$3,098,565

¹ Containing 27 percent or more potassium-oxide (K₂O) equivalent, n. e. s. (25 percent K₂O-content equivalent basis).

² 25 percent K₂O-content equivalent basis.

³ Less than 1 ton.

⁴ United Kingdom of Great Britain and Northern Ireland.

WORLD PRODUCTION

Production returns are available for but few foreign countries in recent years. Operations have been in progress, however, in several countries. Soviet Russia, with its large reserves in the Solikamsk region, controls the potash industry of eastern Europe, and in 1944 the capture of the Polish potash fields added to its reserve. Fersman ¹⁷ in a recent article refers to the discovery of the Solikamsk deposits as giving rise to the establishment of the world's largest potassium industry and describes the Soviet deposits of potassium salts as the most extensive known in the world, 35 times as great as all other known reserves. He considers the Solikamsk deposits able to supply the entire world demand for potassium fertilizers for many thousands of years.

In Western Australia the output of potash from the Lake Champion alunite deposits late in 1944 is reported as about 5 tons daily, with modifications of the plant in process to raise the daily output to 13 tons.

Potash deposits were discovered in exploratory work at the Malagash salt mine in Nova Scotia in 1944. Reserves are estimated as several hundred thousand tons containing an average of 8 percent KCl.

¹⁷ Fersman, Alexander, Science in the U. S. S. R.: Advancement of Science, vol. 3, No. 9, September 1944, pp. 62-77.

[Compiled by B. B. Waldbauer]

POTASH

1469

Country and mineral ¹	1938		1939		1940		1941		1942		1943		1944	
	Output	Equiva- lent K ₂ O	Output	Equiva- lent K ₂ O	Output	Equiva- lent K ₂ O	Output	Equiva- lent K ₂ O	Output	Equiva- lent K ₂ O	Output	Equiva- lent K ₂ O	Output	Equiva- lent K ₂ O
North America: United States, potas- sium salts.....	485, 291	287, 532	496, 007	283, 223	597, 150	344, 437	894, 895	476, 156	1, 149, 810	616, 162	1, 296, 215	670, 534	1, 431, 982	757, 103
South America: Chile, crude potas- sium nitrate.....	(²)	(²)	(²)	(²)	62, 208	8, 585	(²)	(²)	63, 828	(²)	63, 828	(²)	(²)	(²)
Europe:														
France (Alsace), crude potassium salts.....	3, 374, 811	581, 790	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Germany, crude potassium salts:														
Carnallite ³	1, 874, 375	1, 861, 000	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Kainite, sylvinite, and hartsalz.....	14, 567, 896	333	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Italy, alunite.....	2, 778	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Poland, crude potassium salts:														
Kainite.....	120, 100	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Sylvite.....	427, 200	93, 984	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Langbeinite.....	*19, 644	2, 358	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Spain, crude potassium salts.....	449, 572	143, 393	4143, 393	25, 526	4291, 373	89, 653	4314, 938	101, 039	4413, 799	89, 654	4439, 657	71, 000	4683, 520	128, 000
U. S. S. R., crude potassium salts.....	(²)	6 122, 000	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Asia:														
China, potash.....	7 14	(²)	7 4	(²)	3, 317	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Chosen, alunite.....	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
India (British), nitrate of potash.....	8 200	4, 000	8 697	4, 175	(²)	(²)	11, 063	5, 310	7, 110	3, 410	(²)	(²)	(²)	(²)
Palestine, crude potassium salts ⁴	58, 118	29, 039	63, 527	31, 764	88, 961	44, 480	101, 681	50, 840	104, 200	52, 100	(²)	(²)	(²)	(²)
Africa: Eritrea, niccol salts ¹⁰	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Australia, alunite.....	445	(²)	762	(²)	800	(²)	1, 181	4, 784	(²)	(²)	(²)	(²)	(²)	(²)

¹ In addition to countries listed Iran is reported to produce a small quantity of potash salts, but statistics of production are not available.

² Data not available.

³ Includes some natural kieserite.

⁴ Salable.

⁵ Official.

⁶ Estimated production (Imperial Institute, London).

⁷ Exports of potassium carbonate.

⁸ Extracted from waters of Dead Sea.

⁹ Exports.

¹⁰ Extracted from waters of Red Sea.

MICA

By G. RICHARDS GWINN AND ETHEL M. TUCKER

SUMMARY OUTLINE

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SUMMARY

Production and consumption of all kinds of mica except sheet and punch increased in 1944. Domestic production supplied 14 percent of all receipts of the strategic grades of stained and better in 1944, compared with 11 percent in the previous year. The increase is attributed largely to the increased use of the lower grades and improvements in domestic trimming practices.

India and Brazil remain the major producers of block mica, and India is also virtually the sole source of muscovite splittings. Production declined somewhat in India and increased in Brazil in 1944. Madagascar furnished most of the phlogopite block mica for high heat requirements as well as the better grades of phlogopite splittings. Public procurement of Madagascar mica was discontinued at the end of 1944 because of decreased requirements and a favorable stock position. On December 16, 1944, the public procurement of imported mica films was curtailed, and additional films will be purchased on a special order basis.

The premium prices paid to domestic miners by the Colonial Mica Corporation effective June 1942 were not only continued through 1944 but were increased for particular grades and sizes. The number of mica mines operating in the United States in 1944 ranged from 430 to 765 per month with a yearly average of 658 compared with 613 in 1943.

Consideration was given in the early months of 1944 to discontinue immediately the Government-sponsored program for the domestic industry, but because of the inability of the armed forces to furnish accurate information on future requirements and the uncertainty of the foreign supply, the program was continued. However, by the end of the third quarter the supply and stock of strategic mica, especially the smaller sizes, reached such a point that the War Production Board felt it no longer necessary to purchase either domestic or imported green- and black-stained mica. This curtailment was instituted to eliminate the excessive handling and preparation costs entailed in preparing green- and black-stained material.

An excellent though unofficial report on the viewpoint of the United States Army, the current world's largest consumer of mica, toward the supply, uses, and conservation of mica, has recently been published.¹ The War Metallurgy Committee of the National Academy of Sciences, National Research Council, completed a series of investigations on the conservation of strategic mica and alternate materials, the means of overcoming various defects in certain types of mica, commercialization of mica-testing equipment, and mechanical production of mica splittings, which resulted in some definite advances in the production, preparation, and marketing of mica.

The accompanying table of salient statistics gives a summary of domestic production and consumption of mica during the past 5 years.

Salient statistics of the mica industry in the United States, 1940-44

	1940	1941	1942	1943	1944
Domestic mica sold or used by producers:					
Total uncut sheet and punch:					
Pounds.....	1,625,437	2,666,453	2,761,844	3,448,199	1,523,313
Value.....	\$291,685	\$566,858	\$728,030	\$3,228,742	\$3,262,711
Average per pound.....	\$0.18	\$0.21	\$0.26	\$0.94	\$2.14
Scrap: ¹					
Short tons.....	22,386	32,500	43,262	46,138	51,727
Value.....	\$314,565	\$442,789	\$671,165	\$738,025	\$1,069,072
Average per ton.....	\$14.05	\$13.62	\$15.51	\$16.00	\$21.05
Total sheet and scrap:¹					
Short tons.....	23,199	33,833	44,643	47,862	52,489
Value.....	\$606,250	\$1,009,647	\$1,396,195	\$3,966,767	\$4,351,783
Total ground:¹					
Short tons.....	27,984	43,419	46,979	51,582	52,713
Value.....	\$1,016,628	\$1,532,351	\$1,653,358	\$1,990,144	\$1,914,709
Consumption of splittings:					
Pounds.....	4,918,861	7,297,628	6,636,639	8,413,362	8,816,965
Value.....	\$1,725,522	\$2,832,939	\$2,835,421	\$3,518,822	\$4,657,730
Imports for consumption:					
Total uncut sheet and punch:					
Pounds.....	1,534,188	2,016,852	3,244,857	5,501,745	5,032,083
Value.....	\$576,565	\$1,119,584	\$2,141,465	\$6,313,900	\$3,921,078
Scrap:					
Short tons.....	3,061	1,251	2,179	2,048	2,412
Value.....	\$22,611	\$12,791	\$25,879	\$27,102	\$32,688
Total sheet and scrap:					
Short tons.....	3,828	2,259	3,801	4,799	4,928
Value.....	\$599,176	\$1,132,375	\$2,167,344	\$6,341,002	\$3,953,766
Manufactured:					
Short tons.....	3,860	6,041	7,493	8,960	2,314
Value.....	\$1,884,952	\$3,282,656	\$6,860,434	\$8,513,064	\$3,707,718
Total imports:					
Short tons.....	7,688	8,300	11,294	13,759	7,242
Value.....	\$2,484,128	\$4,415,031	\$9,027,778	\$14,854,066	\$7,661,484
Exports (all classes of mica):					
Short tons.....	903	1,163	1,001	693	619
Value.....	\$191,550	\$280,810	\$303,526	\$653,889	\$526,824

¹ Includes mica recovered from kaolin and mica schists, as follows: 1940, 9,674 tons, \$138,148; 1941, 15,583 tons, \$185,486; 1942, 20,481 tons, \$315,807; 1943, 24,113 tons, \$314,851; 1944, 22,107 tons, \$485,567.

² Revised figures.

DOMESTIC PRODUCTION

Sheet mica.—Production of sheet and punch mica reached 1,523,313 pounds valued at \$3,262,711 in 1944 compared with 3,448,199 pounds valued at \$3,228,742 in the previous year. Punch mica supplied 55 percent of the 1944 total or 835,402 pounds valued at \$147,635 com-

¹ Wayland, R. G., Mica in War: Am. Inst. Min. and Met. Eng., Techn. Pub. 1749, July 1944, 7 pp.

pared with 78 percent of the 1943 domestic production or 2,691,083 pounds valued at \$473,955.

North Carolina remained the largest producer in 1944, supplying 49 percent of the total sheet and 57 percent of the punch and circle, compared with 47 and 57 percent, respectively, in 1943.

New Hampshire and South Dakota retained their respective places as the second- and third-largest producers. However, Connecticut ranked fourth in 1944 followed by Georgia; Idaho attained sixth place, and substantial quantities were also received from Virginia, Maine, Alabama, and New Mexico.

Mica sold or used by producers in the United States, 1935-44

Year	Sheet mica						Scrap mica and mica recovered from kaolin and schists		Total	
	Uncut punch and circle mica		Uncut mica larger than punch and circle		Total uncut sheet mica ¹					
	Pounds	Value	Pounds	Value	Pounds	Value				
1935-39 (average)...	888,313	\$46,408	252,411	\$139,306	1,140,724	\$185,714	21,966	\$285,512	22,557	\$471,226
1938.....	774,121	45,566	165,386	93,767	939,507	139,333	20,257	256,382	20,727	395,715
1939.....	665,755	39,207	147,963	99,756	813,708	138,063	24,672	311,895	25,079	450,858
1940.....	1,405,305	116,087	220,132	175,598	1,625,437	291,685	22,386	314,565	23,199	606,250
1941.....	2,342,237	206,947	324,216	359,911	2,666,453	566,858	32,500	442,789	33,833	1,008,647
1942.....	2,425,645	282,900	336,199	442,130	2,761,844	725,030	43,262	671,165	44,643	1,396,195
1943:										
Connecticut.....	165,186	26,528	36,956	38,711	202,142	65,239	304	6,795	405	72,034
Georgia.....	175,228	41,390	37,326	154,432	212,554	195,822	6,251	39,336	6,357	235,158
New Hampshire.....	491,879	171,795	208,664	411,838	700,543	583,543	1,148	28,643	1,496	612,186
North Carolina.....	1,543,016	159,535	358,104	1,612,789	1,901,120	1,772,324	25,295	516,367	26,246	2,388,691
South Dakota.....	248,489	52,674	84,935	394,535	447,209	333,424	2,234	42,764	2,401	480,973
Other States ² ...	67,285	22,123	31,131	142,482	98,416	164,605	10,906	104,120	10,955	268,725
	2,691,083	473,955	757,116	2,754,787	3,448,199	3,228,742	46,138	738,025	47,862	3,966,767
1944:										
Connecticut.....	26,219	9,558	50,857	137,571	77,076	147,129	593	13,798	632	160,927
Georgia.....	39,108	3,647	21,004	115,695	60,112	119,342	5,305	107,135	5,335	228,477
New Hampshire.....	194,538	57,010	129,068	560,162	323,636	617,172	2,339	55,851	2,501	673,022
North Carolina.....	474,680	69,025	340,194	1,461,600	814,874	1,530,625	29,774	750,285	30,181	2,280,910
South Dakota.....	65,649	3,240	80,734	468,786	146,383	472,026	2,568	51,405	2,631	523,431
Other States ² ...	35,208	5,155	66,024	371,262	101,232	376,417	11,168	110,598	11,209	487,015
	835,402	147,635	687,911	3,115,076	1,523,313	3,262,711	51,727	1,069,072	52,489	4,351,783

¹ Includes small quantities of splittings in certain years.

² 1943: Alabama, Arizona, California, Colorado, Idaho, Maine, Maryland, Massachusetts, Montana, Nevada, New Mexico, Pennsylvania, South Carolina, Texas, Virginia, and Wyoming; 1944: Alabama, Arizona, Colorado, Idaho, Maine, Massachusetts, Montana, Nevada, New Mexico, Pennsylvania, Virginia, and Wyoming.

The decrease in the quantity of sheet and punch mica produced and the increase in value are attributed to the premium prices paid by the Colonial Mica Corporation for three-quarter and full trim sheet in sizes from 1- by 1-inch and larger. Trimming to three-quarter or full trim necessarily decreases the quantity of sheet obtained per pound of mica mined, but the increase in prices gained by this trimming more than compensates for the reduced output of the finished product. The decreased output of punch reported in 1944 thus is attributed largely to the increased quantity of the smaller sizes, such as 1- by 1-inch, that were full-trimmed and therefore classed as sheet rather than punch.

Production of sheet and punch mica is not segregated into clear and stained material on Bureau of Mines schedules. However, an index of the quantities of these classes mined may be obtained from the monthly statistics of purchases of clear and stained mica as indicated on a quarterly basis for 1943 and 1944 in figure 1. The increased use of stained mica is reflected in the upswing of purchases which began during the first quarter of 1943 and reached a peak in the first quarter of 1944. Purchases of clear sheet and punch increased through the first three quarters of 1944 and began to decline in the last quarter.

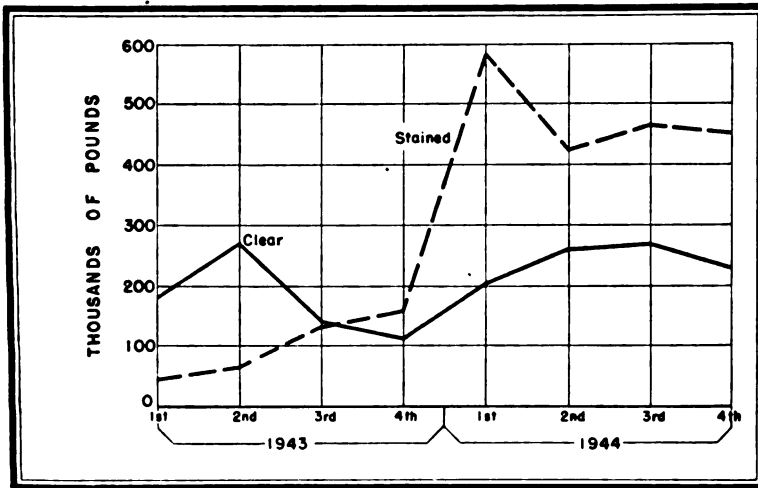


FIGURE 1.—Average monthly purchases of domestic sheet mica, clear and stained, for each quarter, 1943-44

Scrap mica.—Production of scrap mica in 1944 increased to 51,727 short tons, valued at \$1,089,072 compared with 46,138 tons, valued at \$738,025 in 1943. In addition to mine and factory scrap, these figures include 22,107 tons, valued at \$485,567, obtained from washing kaolin and by milling mica schists. Comparable figures for 1943 were 24,113 tons, valued at \$314,851.

Ground mica.—Production of ground mica in 1944 reached a new all-time high of 52,713 short tons, valued at \$1,914,709, compared with 51,582 tons, valued at \$1,990,144, in 1943, the previous record year.

Although ground mica has not been considered of strategic grade, many of the current uses are connected directly with the war program. The new asphalt landing mats produced for the Army consumed large quantities of roofing-grade mica. Clean, white muscovite mica with a low iron content was used in glass-bonded insulation in radio sets. The mica for this use came largely from New England, as the iron content of North Carolina mica is too high. Large quantities were also used in cable and telephone-wire insulation and in paints for waterproofing textile fabrics for the armed forces.

The history of the scrap- and ground-mica industries over a series of years is indicated in figure 2.

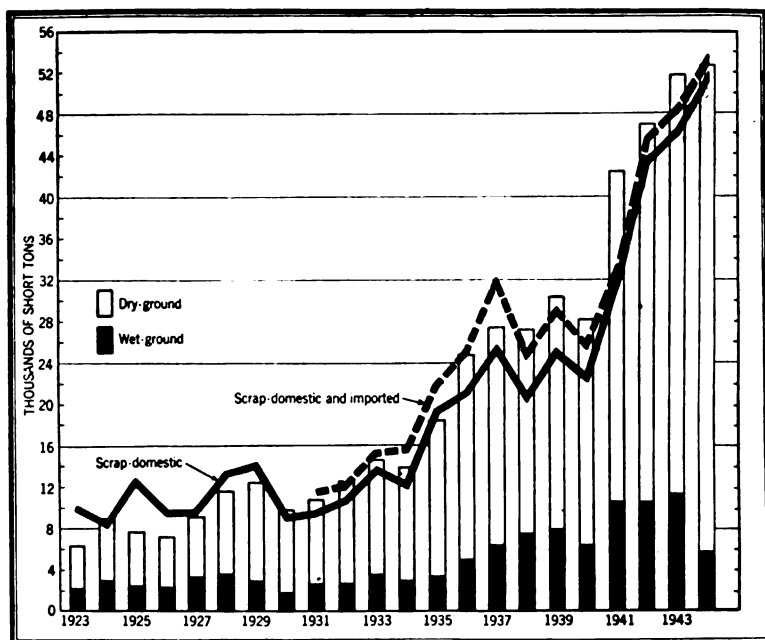


FIGURE 2.—Scrap and ground mica sold in the United States, 1923–44.

Ground mica (including mica from kaolin and schists) sold by producers in the United States to various industries, 1943–44

Industry	1943			1944		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Roofing	29,022	56	\$682,970	21,280	40	\$495,431
Wallpaper	1,814	3	153,937	1,325	3	123,180
Rubber	3,063	6	175,922	1,137	2	95,689
Paint	7,608	15	431,832	5,107	10	329,905
Plastics	2,969	6	293,699	1,079	2	95,887
Miscellaneous	7,106	14	341,784	22,785	43	774,617
	51,582	100	1,990,144	52,713	100	1,914,709

¹ Includes mica used for molded electric insulation, house insulation, Christmas-tree snow, manufacture of axle greases and oil, annealing, pipe-line enamel, textiles, oil-well drilling, welding, and other purposes.

Ground mica (including mica from kaolin and schists) sold by producers in the United States, 1940–44, by methods of grinding

Year	Dry-ground		Wet-ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1940	21,809	\$515,930	6,175	\$500,698	27,984	\$1,016,628
1941	31,914	733,559	11,505	798,792	43,419	1,532,351
1942	36,369	895,163	10,610	848,195	46,979	1,653,358
1943	40,256	1,027,781	11,326	962,363	51,582	1,990,144
1944	47,023	1,382,147	5,690	532,562	52,713	1,914,709

TOTAL CONSUMPTION OF BLOCK AND SHEET MICA

Requirements of the armed forces for mica began to decline during the first quarter of 1944, and the downtrend continued throughout the year. Conservation Order M-101, which defines and controls the allocation of strategic mica, was amended twice during 1944. On September 16 the necessity of filing detailed applications for authorization to fabricate mica that is in plentiful supply was lifted, and on December 12 strategic mica was redefined to include only muscovite ruby block and film sizes 5½ and larger, stained and better qualities. The effective date of the latter amendment was January 1, 1945.

Domestic consumption of strategic mica in 1944, as reported by the War Production Board, was 3,728,800 pounds. Condensers, tubes,

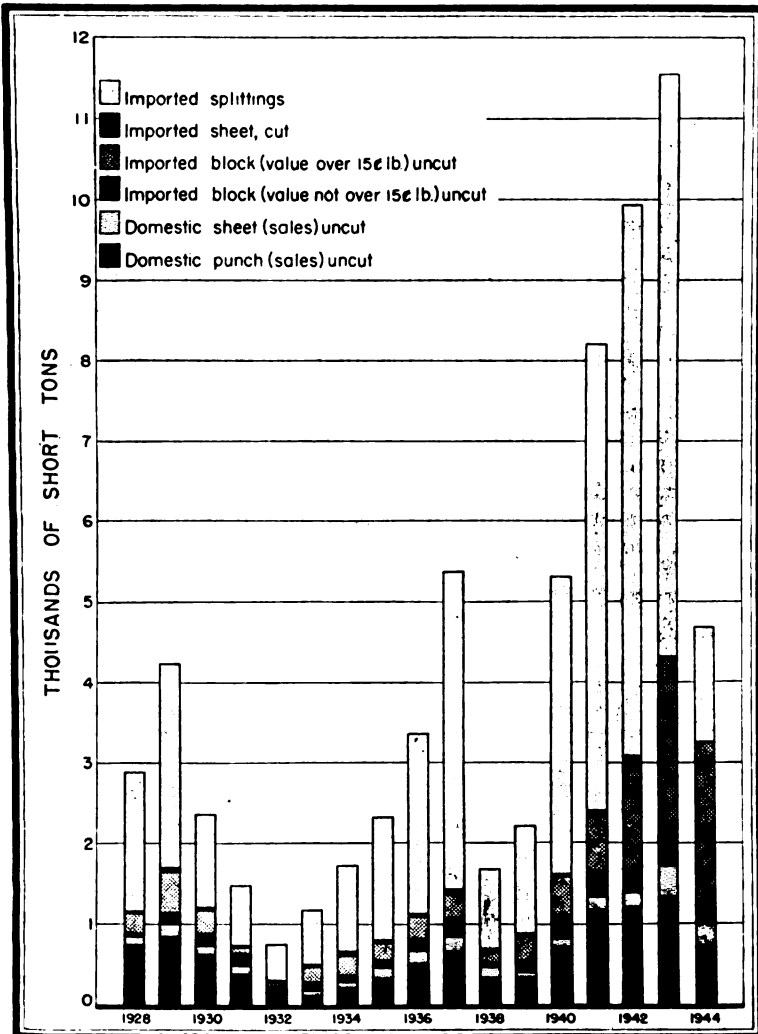


FIGURE 3.—Block and sheet mica (cut) and splittings imported for consumption in the United States and sales of domestic sheet and punch mica, 1928-44.

and other applications required in radio and radar equipment used 65.5 percent of the total. The remainder was consumed in magnetos, spark plugs, gage glass, compass cards, diaphragms, television, and miscellaneous uses. Stocks of the strategic grades on hand December 31, 1944, were adequate for approximately 16 months' supply at the average rate of consumption during 1944.

Figure 3 summarizes graphically the situation with respect to imports and domestic production.

MICA SPLITTINGS

Consumption of splittings reached a new high of 8,816,965 pounds in 1944, an increase of 403,603 pounds over the previous record high of 8,413,362 pounds in 1943.

Stocks of muscovite and amber splittings decreased in 1944, Government stocks declined from 19,518,691 pounds on January 1 to 12,400,261 pounds on December 31, 1944, and year-end industry stocks of 3,994,977 pounds were 522,234 pounds below the corresponding figure for 1943.

The research program of the National Academy of Sciences, National Research Council, on various mechanical methods of preparing splittings showed that it does not appear economically feasible to produce splittings from individual blocks of mica with any of the machines developed so far.

The first direct Government control of the use of mica splittings was instituted on March 15, 1944, under War Production Board Conservation Order M-101-a, which limited the use of No. 5 or larger book-form muscovite splittings to the manufacture of composite or built-up mica insulation in which the mica content is limited to an average thickness of not more than 0.003-inch, including binder. As a result of this order and completion or termination of certain military programs, the stocks of these sizes have increased to a favorable level. Peak consumption of muscovite splittings was reached in the first quarter, with a decline through the second and third quarters and an upswing in the last quarter. Amber splittings also reached a peak

Consumption and stocks of mica splittings in the United States, 1940-44, by sources, as reported by the consumers

Year	India		Canada		Madagascar		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Consumption:								
1940.....	4,252,120	\$1,358,534	54,044	\$28,491	612,997	\$338,497	4,918,861	\$1,725,522
1941.....	6,473,459	2,334,432	179,783	181,350	644,386	367,157	7,297,628	2,832,939
1942.....	5,998,614	2,415,709	117,295	79,752	520,730	339,960	6,636,639	2,835,421
1943.....	7,649,596	3,054,995	344,966	172,674	337,099	233,788	8,413,362	3,518,822
1944.....	7,708,253	4,002,010	601,661	324,631	371,972	251,945	8,816,965	4,657,730
Stocks in consumers' hands Dec. 31:								
1940.....	4,620,934	1,776,974	53,378	35,581	738,489	410,068	5,412,801	2,222,623
1941.....	9,212,891	3,434,336	115,529	81,988	223,235	134,143	9,561,655	3,650,467
1942.....	8,202,240	3,367,788	257,591	178,082	321,529	201,274	8,781,360	3,747,144
1943.....	4,031,849	1,708,096	138,564	85,893	215,639	139,797	4,517,211	2,032,758
1944.....	3,578,885	1,749,011	141,427	95,850	184,970	121,307	3,994,977	2,025,165

¹ Revised figure for consumption includes 26,510 pounds of domestic splittings and 55,191 pounds of Mexican splittings, valued at \$11,308 and \$48,057, respectively; stocks include 2,200 pounds of domestic splittings and 128,959 pounds of Mexican splittings, valued at \$1,009 and \$97,963, respectively.

² Consumption includes 58,350 pounds of domestic and 76,729 pounds of Mexican splittings, valued at \$23,862 and \$55,282, respectively; stocks include 3,694 pounds of domestic and 86,001 pounds of Mexican, valued at \$1,365 and \$57,632, respectively.

in the first quarter, declined in the second and third quarters, and increased through the last quarter. Grade 6 loose splittings—first-, second-, and third-quality—in 1944 constituted 79 percent of the total consumption of muscovite splittings, compared with 81 percent in 1943. The 2-percent decrease is attributed largely to a new class of No. 6 splittings—lower than third-quality, set up late in 1944. The consumption of No. 2 quality was greater than Nos. 1 and 3, and No. 1 was greater than No. 3.

The better phlogopite splittings were obtained from Madagascar. Some lower-grade splittings were obtained from Canada and Mexico, and small quantities of machine splittings were manufactured domestically from phlogopite obtained from mine dumps in Canada.

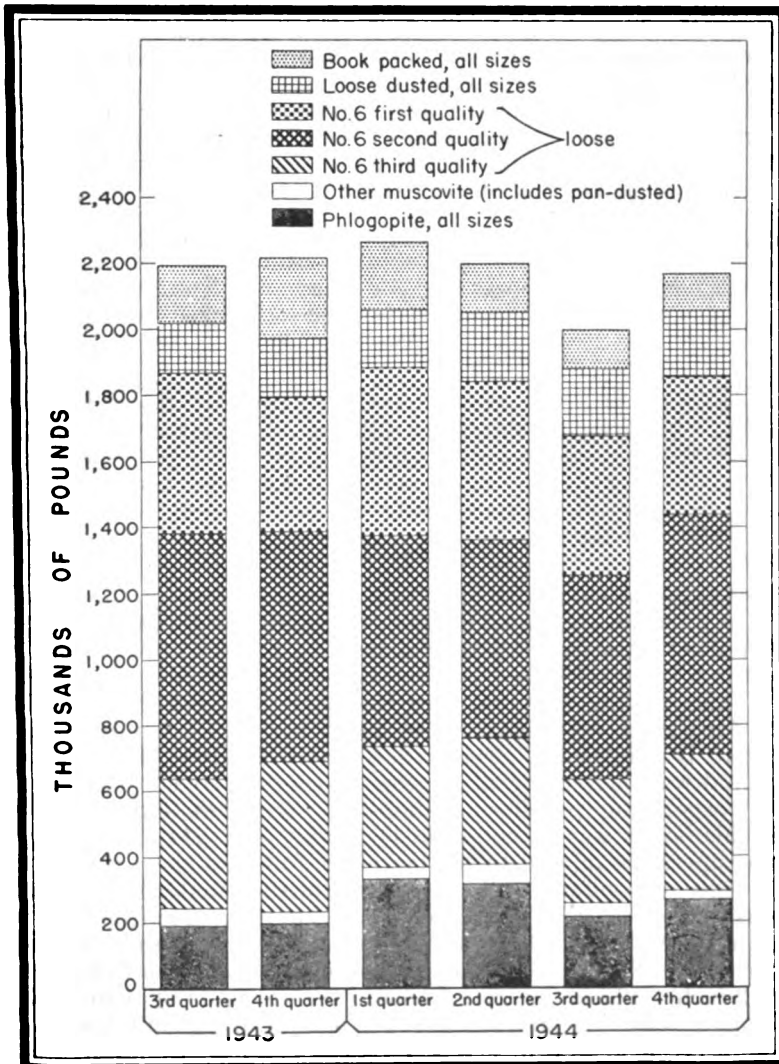


FIGURE 4.—Consumption of specified sizes and qualities of mica splittings in the United States, by quarters, July 1943 to December 1944.

India is the sole source of muscovite splittings. As the demand and supply of this type reached a favorable balance near the end of the year, the War Production Board favored revocation of Conservation Order M-101-a, but for security reasons and indeterminable supply requirements of the armed forces the order was continued. Consumption of splittings from July 1943 through December 1944 is summarized graphically upon a quarterly basis in figure 4.

BUILT-UP MICA

The consumption of built-up mica products in 1944 increased approximately 9 percent over the 1943 figure and reached a new high of 7,438,249 pounds valued at \$10,143,940. Segment plates, used largely in the form of commutator segments and cones, made up 34 percent of the total built-up mica produced. Molding plate used in the manufacture of molded commutator rings, channels, and mica tubes accounted for 24 percent of the total, "all other tape, etc.," consumed an additional 26 percent of the total. The remaining 16 percent was used in heater plate, a rigid product capable of withstanding direct contact with high heat, and flexible plate that may be readily formed to a variety of shapes without the application of heat.

*Built-up mica produced in the United States, 1943-44, by kinds of product*¹

Product	1943		1944	
	Pounds	Value	Pounds	Value
Molding plate.....	1,785,000	\$1,912,000	1,792,052	\$1,816,920
Segment plate.....	2,388,000	2,846,000	2,521,527	3,073,074
Heater plate.....	235,000	462,000	364,773	372,663
Flexible (cold).....	707,000	831,000	817,255	1,004,719
All other (tape, etc.).....	1,716,000	3,222,000	1,942,642	3,876,477
	6,831,000	9,273,000	7,438,249	10,143,933

¹ Partly estimated.

PRICES

The buying schedule for domestic mica released by the Colonial Mica Corporation on May 24, 1943, which offered a fixed price for all sizes of sheet mica from 1½ to 2 inches and up of \$5 per pound, provided the mica is three-quarter trim or better; 40 cents per pound for punch mica having a usable area less than 1½ by 2 inches; \$5 per pound for sizes 1- by 1-inch up to 2½ inches; full trimmed, was extended to December 31, 1944. On January 28, 1944, a bonus of \$1 per pound was offered for all strategic mica delivered to the Colonial Mica Corporation purchasing shops on or before June 30, 1944. Later this bonus was extended to December 31, 1944.

Some operators offered to sell large-size full-trim sheet if an appropriate price was offered. The purchase of such material was advantageous to the Government; therefore, during the period from August 7 through December 31, 1944, the Colonial Mica Corporation paid \$8 per pound for Nos. 1 and 2 quality domestic sheet mica full-trimmed 1½ by 2 inches and larger, \$6 per pound for sheets 1- by 1-inch to 1½ by 2 inches full trim, and 40 cents per pound for punch mica.

The prices for scrap mica ranged from \$17 per short ton, f. o. b. mine, in the western region to \$25 per ton in North Carolina and New England. Dry-ground mica was quoted at \$35 per ton, f. o. b. mill,

and the wet-ground product brought \$65 to \$80 per ton, f. o. b. mill. A table of average values for sheet and punch mica is not shown, because the premium prices paid by the Colonial Mica Corp. would distort the figures.

MICA SUBSTITUTES

The use of substitute or alternate materials, such as ceramics, glass, silicone resin and rubber, Lectrofilm, and paper, as well as the increased cost of mica, have contributed to the decreasing demand for sheet and punch mica. Polystyrene and a new Dupont product called Poly F 11 also have wide application in the field formerly controlled entirely by mica.

Continued research on ceramics has led to their increased use in capacitors and spark plugs. Ceramic spark plugs have largely replaced mica spark plugs in aircraft motors, except for seaplanes, where mica plugs have a greater margin of safety to the thermal shock involved when spray hits hot spark plugs as planes alight on the water. Glass capacitors have been approved by the Navy as replacement for mica capacitors, and the Army is expected to approve their use shortly. However, paper is still the chief substitute for mica in capacitors. The resin in Lectrofilm is used as an impregnant for paper radar capacitors and increases their temperature range.

Mica is still an essential component in communication and the insulation industry, but the number of places in which mica is essential in these industries has been permanently reduced.

POSTWAR OUTLOOK

It is believed that the quantity of punch and sheet mica produced by domestic mines in the postwar years will approximate the prewar level, very closely, but the dollar value may be somewhat higher. The increased value is attributed to the improvement in trimming practices developed during the war. Domestic sheet mica is now prepared largely as full-trim material in contrast to half-trim preparation before 1942. The increased price paid for full-trim material, however, will not be adequate to allow domestic producers to compete with imported material on an equal basis.

Most of the enlarged wartime production has come from already operating or reopened mines, and few new deposits of exceptional richness have been developed. No new techniques or machinery has been devised to reduce costs, and thus mining is still largely a speculative enterprise. It is believed, therefore, that with the exception of a few large mines, the postwar mica industry will exist largely as a byproduct of feldspar mining.

FOREIGN TRADE¹

Imports.—In 1944 imports of all kinds of mica totaled 7,242 short tons valued at \$7,661,484 compared with 13,759 tons valued at \$14,854,066 in 1943. Imports of all classes of mica declined except waste and scrap (duty, 25 percent), untrimmed phlogopite (1 by 2 inches), and mica cut or stamped to dimensions, which show an increase over the 1943 total. The greatest decline was in films and splittings, the receipts of which decreased from 16,900,779 pounds in 1943 to 4,091,621 pounds in 1944. The general decline in imports and

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

particularly the large decline in imports of splittings are attributed to the relatively large stock piles of mica in the United States and the belief that the European War would end in 1944. It was felt therefore that consumption requirements could be met largely from stocks, and import quotas were reduced. Further details on imports, by kinds and sources of origin, may be found in the following tables.

Mica imported for consumption in the United States in 1944, by kinds and by countries

Country	Unmanufactured									
	Waste and scrap, valued not more than 5 cents per pound				Untrimmed phlogopite mica from which no rectangular piece exceeding in size 1 inch by 2 inches may be cut (duty, 10 percent)		Other			
	Phlogopite (duty, 15 percent)		Other (duty, 25 percent)				Valued not above 15 cents per pound n. e. s. (duty, 4 cents per pound)		Valued above 15 cents per pound (duty, 4 cents per pound + 25 percent)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa:										
Anglo-Egyptian Sudan									3,382	\$3,386
Belgian Congo									2,163	4,961
British East Africa									1,599	1,599
Gold Coast									672	1,062
Madagascar									180,066	357,625
Mozambique									1,095	1,094
Portuguese Guinea and Angola									4,716	11,998
Southern Rhodesia									273	273
Argentina							100,952	\$13,708	467,335	386,527
Bolivia									1,169	227
Brazil							12,144	924	1,590,680	1,157,215
Canada	3,407,500	\$21,686	1,196,195	\$10,006	518,195	\$74,698	383,047	21,904	248,508	488,868
Colombia									1,204	1,204
Guatemala									2,010	1,329
India and dependencies							3,100	350	1,326,539	1,254,437
Mexico	55,219	77					83	13	85,112	68,922
Peru			165,162	919					83,669	55,970
Portugal									17,245	12,692
Total: 1944	3,462,719	21,763	1,361,357	10,925	518,195	74,698	499,331	36,969	4,015,457	3,806,391
1943	3,753,620	24,216	343,200	2,886	293,555	40,392	770,392	80,707	4,437,796	6,192,711

Country	Manufactured—Films and splittings							
	Not cut or stamped to dimensions				Cut or stamped to dimensions (duty, 45 percent)		Total films and splittings	
	Not above 12 ten-thousandths of an inch in thickness (duty, 25 percent)		Over 12 ten-thousandths of an inch in thickness (duty, 40 percent)					
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa:								
Gold Coast					300	\$600	300	\$600
Madagascar	769,374	\$438,265	101,235	\$101,235			870,609	\$539,500
Portuguese Guinea and Angola	12,378	123					12,378	123
Argentina			2,262	3,486	500	1,000	2,762	4,486
Australia					380	6,936	380	6,936
Brazil			1,867	4,680			1,867	4,680
Canada	57,809	38,950					57,809	38,950
Colombia					139	279	139	279
Guatemala	179	53	103	250			282	303
India and dependencies	1,980,429	855,981	899,036	1,804,717	149,097	288,688	3,028,562	2,949,386
Mexico	35,865	22,136	77,612	87,905	3,056	21,697	116,533	131,738
Total: 1944	2,856,034	1,355,508	1,082,115	2,002,273	153,472	319,200	4,091,621	3,676,981
1943	14,510,415	4,095,231	2,369,689	4,188,818	20,645	40,999	16,900,779	8,326,046

Country	Manufactured—Cut or stamped to dimensions, shape, or form (duty, 40 percent)		Manufactured—Other			
			Mica plates and built-up mica (duty, 40 percent)		Ground or pulverized (duty, 15 percent)	
	Pounds	Value	Pounds	Value	Pounds	Value
Australia.....			245	\$5,382		
Canada.....			54	136	530,909	\$15,994
India and dependencies.....	125	\$134				
Mexico.....	5,728	9,091				
Total: 1944.....	5,853	9,225	399	5,518	530,909	15,994
1943.....	50,807	58,738	132,274	110,284	535,800	18,994

Exports.—Exports of unmanufactured mica in 1944 increased in quantity over the previous year's total but declined in value. The quantity increase is attributed to greater exports of nonstrategic sheet and scrap to Canada and Trinidad, the latter being a new export market. The lower dollar value is due to reduced exports of sheet mica to the United Kingdom. Exports of manufactured mica of all kinds were lower in 1944 than in 1943. Details on exports by countries and kinds of mica shipped may be found in the following table.

Mica and manufactures of mica exported from the United States in 1944, by countries

Country	Unmanufactured		Manufactured			
			Ground or pulverized		Other	
	Pounds	Value	Pounds	Value	Pounds	Value
North America:						
Bermuda.....					75	\$293
Canada.....	92,443	\$4,683	571,091	\$30,945	152,591	355,449
Cuba.....	110	450	27,103	869	810	2,242
Iceland.....	10,000	240			439	713
Mexico.....	39,849	12,829	13,359	912	14,119	22,664
Trinidad and Tobago.....	60,480	1,707			42	45
Other North America.....			50	50	939	3,656
South America:						
Argentina.....			3,300	73		
Bolivia.....					218	365
Brazil.....			13,400	1,078	6,741	12,288
Chile.....			4,150	187	3,776	7,248
Colombia.....			500	40	1,312	1,687
Ecuador.....					303	407
Peru.....			4,780	229	162	211
Uruguay.....					579	1,966
Venezuela.....			70,000	2,025	142	286
Other South America.....	5	15			36	31
Europe:						
U. S. S. R.....					3,289	39,991
United Kingdom ¹	375	1,400			939	5,026
Other Europe.....	11	176				
Asia:						
China.....					2,654	2,932
India and dependencies.....			81,520	2,218	110	329
Other Asia.....					273	500
Africa:						
Algeria.....					1,760	1,705
French Morocco.....			53	8	462	596
Union of South Africa.....	10,000	500	41,300	1,556	142	234
Other Africa.....					562	945
Oceania.....					1,040	2,815
Total: 1944.....	213,273	22,010	830,606	40,190	193,515	464,624
1943.....	178,639	147,524	957,751	37,352	250,191	460,013

¹ United Kingdom of Great Britain and Northern Ireland.

WORLD PRODUCTION

Complete data on world production are not available at this time, but the quality of the mica mined in the major producing countries continues to improve. The following table presents available figures by countries from 1938 to 1944.

World production of mica, 1938-44, in metric tons¹

[Compiled by B. B. Waldbauer]

Country ²	1938	1939	1940	1941	1942	1943	1944
North America:							
Canada (sales).....	470	969	819	1,582	2,731	3,652	2,761
Guatemala.....					13	5	5
Mexico.....	(³)	(³)	139	136	44	104	111
United States (sold or used by producers) ⁴	18,803	22,751	21,046	30,693	40,499	43,419	47,617
South America:							
Argentina.....	250	298	442	540	625	440	167
Bolivia (exports).....	4		1	3	3	2	2
Brazil (exports).....	521	435	1,117	867	866	796	941
Peru.....	24	9	4	8	5	9	113
Europe:							
Italy.....	122	26	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)
Norway (exports).....	104	26	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)
Portugal.....				(⁵)	(⁵)	219	1,200
Rumania.....	22	18	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)
Spain.....			20	215	334	387	286
Sweden.....	131	126	91	(⁵)	(⁵)	(⁵)	(⁵)
Asia:							
Ceylon.....	(⁵)	(⁵)	12	(⁵)		2	2
India, British (exports).....	8,896	10,104	8,654	10,584	8,729	9,382	(⁵)
Africa:							
Eritrea.....		10	7				(⁵)
Madagascar.....	677	(⁵)	531	479	320	343	493
Nigeria.....	3	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)
Portuguese East Africa.....		17	(⁵)		1	(⁵)	(⁵)
Portuguese West Africa.....		(⁵)	2	1	(⁵)	1	4
Rhodesia:							
Northern.....	4	2	2	(⁵)	(⁵)	(⁵)	(⁵)
Southern.....	13	6	6	9	14	30	(⁵)
Tanganyika Territory.....	37	36	10	5	13	28	128
Union of South Africa: Transvaal.....	1,116	972	1,252	1,076	1,265	1,274	1,572
Oceania:							
Australia.....	74	88	106	128	206	88	(⁵)
New Zealand.....	(⁵)	1		(⁵)	(⁵)	(⁵)	(⁵)

¹ In addition to the countries listed mica is also produced in Chosen, Colombia, Kenya, Uganda, U. S. R., and Uruguay, but data on production are not available.

² Exports.

³ Data not available.

⁴ Includes following quantities recovered from kaolin and schists—1938: 5,942 tons; 1939: 9,062 tons; 1940: 8,776 tons; 1941: 14,137 tons; 1942: 18,580 tons; 1943: 21,875 tons; 1944: 20,055.

⁵ Estimate.

⁶ Less than 1 ton.

⁷ January to June, inclusive.

Argentina.—The Argentine Republic in 1944, as in the previous year, was our third-largest source of strategic mica. The major part of the mica obtained from Argentina is classed as stained mica and is made up largely of No. 6 and smaller. In August 1944 the United States Government through the United States Commercial Company began public purchase from this source, but the contract was terminated June 30, 1945, in accordance with the policy of returning trade to normal channels as soon as possible.

Brazil.—Production of the better grades of mica in Brazil continued to increase through 1944, and approximately 32 percent of the United States supply of the strategic grades in 1944 came from Brazilian mines.

Canada.—Production of block mica in Canada in 1944 came from Quebec and Ontario, and mica schist was mined in British Columbia.

Muscovite mica originated almost entirely from the Purdy Mica mines in the Eau Claire district of Ontario. A conspicuous feature of the mica from the Purdy mines is the large size of the crystals or books, some of which measure 5 by 6 feet. The following production in 1944, by Provinces, was reported by the Department of Trade and Commerce, Dominion Bureau of Statistics: Quebec, 761 short tons, valued at \$159,454; Ontario, 1,747 tons, valued at \$618,021; and British Columbia, 500 tons, valued at \$10,600. The production of phlogopite mica also increased, and large quantities of phlogopite waste from the mines were exported to the United States for processing into splittings by mechanical methods.

India.—India remains the dominant world supplier of mica, although production was lower in 1944 than in the previous year. The Government of India has set up an inquiry committee to investigate the Indian mica industry. The committee will consider postwar reconstruction, labor problems, and the ultimate stabilization of the industry.

Madagascar.—Production on this island in 1944 was small. After being blockaded for 2 years, producers recently obtained gasoline and mining equipment. However, the French Government, in an effort to rehabilitate industry, raised the selling price of block mica 35 percent and splittings 25 percent. This served to reduce production because the United States and Great Britain declined to meet the new price and made no contracts for Madagascar mica in 1945.

Southern Rhodesia.—Production of muscovite mica in Southern Rhodesia has been stimulated by the increased wartime requirements of Great Britain. The Southern Rhodesia mica industry was subsidized by the Government in much the same manner as the United States domestic industry. All mica produced must be sold to Associated Insulated Products, Ltd., an African company appointed by the Government of the Colony. There are three mica fields: Lomagundi, 120 miles northwest of Salisbury; Rusambo, about 100 miles northeast of Salisbury near the Portuguese border; and Fungwe, immediately north of the Rusambo field.

The Lomagundi field is the principal producer. It is reported that the mica industry employed 2,500 men in 1944 and furnished an estimated 30 percent of the requirements of the United Kingdom for "clear" and "slightly stained" grades of mica.

SALT

By FLORENCE E. HARRIS AND E. M. TUCKER

SUMMARY OUTLINE

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SUMMARY

A peak record of 15,717,171 short tons of common salt of three types valued at \$45,989,264, produced in the United States in 1944, represented increases of 3 percent in quantity and 5 percent in value compared with the totals in 1943.

Output of rock salt increased 6 percent and salt in brine 5 percent; evaporated salt decreased 1 percent.

The chief factors contributing to the increased quantity were expanded chemical uses, augmented production of synthetic rubber, and larger quantities used in making magnesium metal, despite the drastic cut-back in this industry.

Demand could scarcely keep pace with supply, chiefly because of labor shortage. Shipments were hampered by shortages of gasoline for trucks and scarcity of freight cars. During 1944, containers such as bags, paper cartons, and shipping cartons, continued scarce. Some industrial users overcame the situation when possible by supplying their own used sacks. A price allowance of several dollars per ton was made by the sellers for salt sold in buyers' sacks from that asked for it in sellers' sacks. In some sections of the Southwest, where drought had occurred, the livestock were removed, and sales shifted to other regions.

Salient statistics of the salt industry in the United States, 1935-39 (average) and 1941-44

	1935-39 (average)	1941	1942	1943	1944
Sold or used by producers:					
Manufactured (evaporated) short tons	2,507,374	3,330,106	3,517,832	3,993,899	3,942,621
In brine do	4,205,587	6,771,436	7,373,165	7,961,115	8,326,312
Rock salt do	1,947,264	2,619,087	2,802,287	3,259,138	3,448,238
Total:					
Short tons	8,660,215	12,720,629	13,693,284	15,214,152	15,717,171
Value ¹	\$23,405,612	\$33,620,376	\$38,144,234	\$43,878,266	\$45,989,264
Average per ton ¹	\$2.70	\$2.64	\$2.79	\$2.88	\$2.93
Imports for consumption:					
For curing fish short tons	21,250	7,426	6,434		
Value	\$43,722	\$30,058	\$17,667		
In bags, barrels, etc short tons	1,385	1,110	367	129	14
Value	\$11,813	\$12,156	\$4,138	\$2,425	\$700
In bulk short tons	24,131	6,896	953	1,129	5,540
Value	\$55,876	\$17,021	\$7,496	\$10,325	\$31,459
Total:					
Short tons	46,766	15,432	7,754	1,258	5,554
Value	\$111,411	\$59,235	\$29,301	\$12,750	\$32,159
Exports:					
Short tons	90,214	123,195	118,424	145,803	198,368
Value	\$521,652	\$807,925	\$892,160	\$1,173,139	\$1,620,176
Apparent consumption² short tons	8,616,767	12,612,866	13,682,614	15,069,607	15,524,357

¹ Values are f. o. b. mine or refinery and do not include cost of cooerage or containers.

² Includes salt in bags, sacks, barrels, or other packages—1942: 122 tons, \$1,200.

³ Quantity sold or used by producers plus imports minus exports.

The accompanying graph (fig. 1) illustrates the continued rise in sales of all types of salt compared with the Federal Reserve Board index for industrial production. In terms of index numbers based on percentages of the 1935-39 average output, salt in brine rose 9

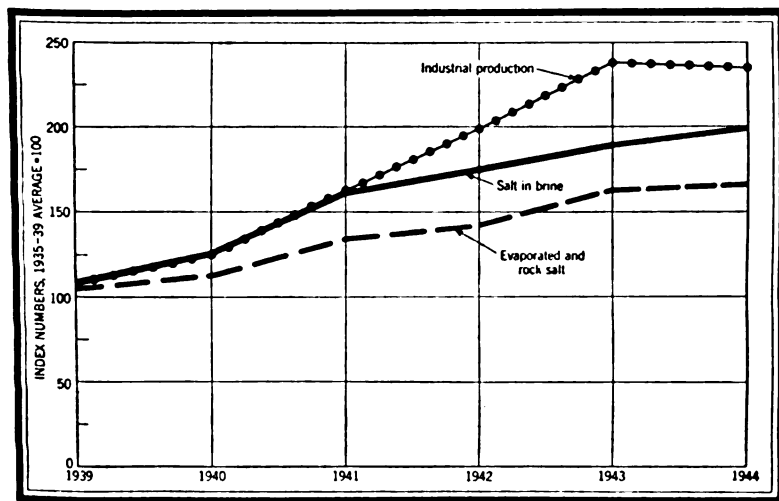


FIGURE 1.—Index of salt in brine and of evaporated and rock salt compared with industrial production, 1939-44. Index of industrial production from Federal Reserve Board.

points in 1944, reaching 198, and evaporated and rock salt combined rose 3 points, whereas the index for industrial production declined 4 points to 235.

Puerto Rican producers also reported good demand for salt throughout the year, and sales depleted all stocks. Production could not keep pace, as the effects of the damage sustained by the flood caused by the hurricane of October 1943 extended into 1944. During the second quarter of 1944 heavy rains reduced the yields further. All the salt produced on the island is solar salt and is used locally.

PRODUCTION

In 1944, salt was produced in 81 plants of 53 companies operating in 13 States and Puerto Rico, compared with 83 plants of 57 companies in 1943.

Production by States.—As for years past, Michigan led in total salt produced, followed by New York, Ohio, Louisiana, Texas, Kansas, and California. The Midwest section (Kansas, Michigan, and Ohio) produced 52 percent of the national total in 1944 compared with 53 percent in 1943. Michigan and New York together produced 46 percent of the 1944 output, Michigan leading in evaporated salt and New York in rock salt.

Salt sold or used by producers in the United States, 1942-44, by States

State	1942			1943			1944		
	Quantity		Value	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total		Short tons	Percent of total	
California.....	546,320	4	\$2,494,485	596,015	4	\$2,839,560	712,558	5	\$3,138,135
Kansas.....	860,083	6	3,809,321	945,287	6	4,197,507	932,238	6	4,357,217
Louisiana.....	1,332,129	10	3,381,856	1,620,382	11	3,678,068	1,843,728	12	4,102,020
Michigan.....	3,946,591	29	12,583,964	4,284,685	28	14,472,820	4,287,758	27	14,921,719
New Mexico.....	13,956	(¹)	47,265	10,829	(¹)	21,427	23,759	(¹)	105,560
New York.....	2,722,670	20	8,158,147	2,926,388	19	9,328,672	2,925,675	19	9,899,590
Ohio.....	2,711,188	20	3,864,588	2,818,928	19	3,824,508	2,891,395	18	4,076,481
Oklahoma.....	8,305	(¹)	35,132	7,716	(¹)	30,496	(¹)	(¹)	(¹)
Puerto Rico.....	18,198	(¹)	103,071	17,505	(¹)	109,337	13,620	(¹)	87,114
Texas.....	821,111	6	2,202,527	1,127,854	7	3,610,532	1,147,397	7	3,627,528
Utah.....	110,871	1	290,040	169,810	1	562,293	119,809	1	368,500
West Virginia.....	140,216	1	822,794	230,329	2	923,499	359,217	2	1,027,109
Other States ²	461,646	3	351,044	458,424	3	279,547	460,017	3	277,951
	13,693,284	100	38,144,234	15,214,152	100	43,878,266	15,717,171	100	45,989,264

¹ Less than 0.5 percent.

² Included in "Other States."

³ 1942: Colorado, Nevada, and Virginia; 1943: Nevada and Virginia; 1944: Oklahoma, Nevada, and Virginia.

The following chart (fig. 2) depicts the tonnages of the three categories of salt obtained from 1939 to 1944, inclusive.

Methods of manufacture.—Various methods of manufacture are employed for the salt obtained from natural and artificial brine wells, ponds, sea water, and bedded deposits that are mined. None of the basic methods were changed or modified materially in 1944. The quantities made by each method utilized are given in the accompanying table.

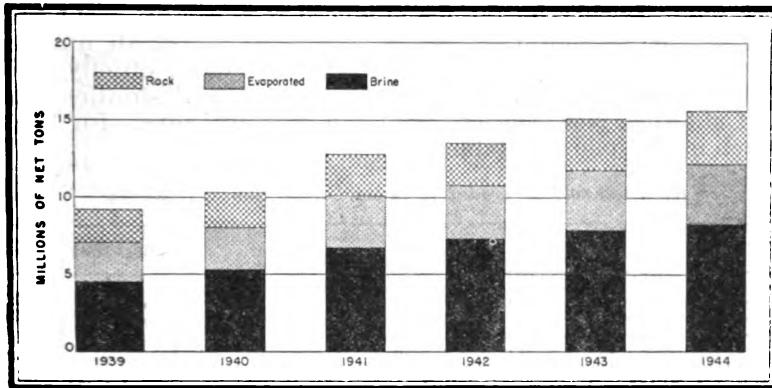


FIGURE 2.—Trends in the quantity of rock salt, evaporated salt, and brine (in terms of salt content) sold or used by producers in the United States, 1939-44.

Salt sold or used by producers in the United States, 1943-44, by methods of manufacture

Method of manufacture	1943		1944	
	Short tons	Value	Short tons	Value
Evaporated:				
Bulk:				
Open pans or grainers.....	532,747	\$5,083,816	531,091	\$5,452,399
Vacuum pans.....	2,593,816	16,509,975	2,589,832	17,387,166
Solar.....	598,772	2,538,341	547,482	1,963,790
Pressed blocks.....	269,064	2,598,873	274,216	2,797,015
Rock:				
Bulk.....	3,181,226	10,512,857	3,369,175	11,500,601
Pressed blocks.....	77,912	668,027	79,063	724,456
Salt in brine (sold or used as such).....	7,961,115	5,966,377	8,326,312	6,163,857
	15,214,152	43,878,266	15,717,171	45,989,264

Evaporated salt.—Fifty-six plants produced evaporated salt in 12 States and Puerto Rico, chiefly in Michigan, Texas, California, Ohio, New York, and Kansas.

Evaporated salt sold or used by producers in the United States, 1943-44, by States

State	1943		1944	
	Short tons	Value	Short tons	Value
California.....	486,013	\$2,579,509	550,049	\$2,804,964
Kansas.....	379,666	2,921,912	373,112	3,085,161
Louisiana.....	64,547	478,357	58,560	462,597
Michigan.....	1,198,062	7,841,282	1,103,825	7,998,207
New York.....	447,749	4,909,059	490,181	5,296,840
Ohio.....	467,156	3,365,293	480,469	3,562,181
Oklahoma.....	7,716	30,496	(¹)	(²)
Puerto Rico.....	17,505	109,337	13,620	87,114
Texas.....	(³)	(³)	(³)	(³)
Utah.....	161,967	526,999	112,182	330,365
West Virginia.....	144,112	906,076	150,286	981,980
Other States ⁴	619,406	3,059,685	620,337	3,118,641
	3,993,899	26,731,005	3,942,621	27,600,350

¹ Includes a quantity of salt contained in brine for chemical use reported as evaporated salt with value as evaporated salt.

² Included under "Other States."

³ 1943: Nevada, New Mexico, and Texas; 1944: Oklahoma, Nevada, New Mexico, and Texas.

Rock salt.—Twenty operations produced rock salt in eight States. Output cannot be shown by States because of the small number of producers involved. However, rock salt is produced chiefly in New York, Louisiana, Kansas, Michigan, and Texas; and smaller quantities in California, New Mexico, and Utah. Annual totals for 1940-44 are given in the following table:

Rock salt sold by producers in the United States, 1940-44

Year	Short tons	Value	Year	Short tons	Value
1940.....	2,265,548	\$7,384,839	1943.....	3,259,138	\$11,180,584
1941.....	2,619,087	8,761,827	1944.....	3,448,238	12,225,057
1942.....	2,802,287	9,623,461			

Pressed blocks.—Twenty-one evaporated-salt plants and eight rock-salt plants supplied the output of pressed blocks reported. They were made of plain, iodized, and sulfurized salt.

Pressed-salt blocks sold by original producers of the salt in the United States, 1940-44

Year	From evaporated salt		From rock salt		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	152,267	\$1,193,237	40,171	\$282,435	192,438	\$1,475,672
1941.....	182,331	1,505,040	56,701	461,265	239,032	1,966,305
1942.....	240,354	2,228,062	67,490	569,014	307,844	2,797,076
1943.....	269,064	2,598,873	77,912	668,027	346,976	3,266,900
1944.....	274,216	2,797,015	79,063	724,456	353,279	3,521,471

Salt content of brine.—Twelve plants in seven States produced 8,326,312 short tons of salt in brine in 1944 or 53 percent of total salt produced.

CHANGES IN THE INDUSTRY

Several companies that ceased operations in 1943 were still idle in 1944. Others ceased operations in 1944, including The Irvine Co., Tustin, Calif., and W. F. Flowers and Dee Stockman, Erick, Okla. Ezra S. Blackmon leased the solar salt playa formerly worked by Eklund-Blackmon Salt Co., Freedom, Okla. The Potash Co. of America, Carlsbad, N. Mex., sold ground rock salt produced as a byproduct from its potash mine. The Morton Salt Co. plant at Marysville, Mich., the company's largest Midwest establishment, was inactive part of 1944 owing to a fire that destroyed the packing and shipping departments. The Morton Salt Co., through its wholly owned subsidiary, Brine Products Inc., purchased the plant of the original Union Salt Co., Cleveland, Ohio, on May 31, 1944, and subsequently changed the name of the Brine Products Co. to the Union Salt Co., taking the name of the predecessor company.

DISTRIBUTION

The only available measure of consumption by States is the record of original shipments into States by producers. Reshipments are disregarded. In the accompanying table, salt shipped to destinations

within a State in which it is produced is added to that shipped from other States.

Shipments into a State during a year may not equal the consumption during that year but over a period of years should afford a fair index of consumption. In view of the fact that, because of its nature, salt is not stored for a great length of time, the margin of difference probably is narrow.

*Distribution (shipments) of evaporated and rock salt in the United States, 1943-44
by States of destination, in short tons*

Destination	1943		1944	
	Evaporated	Rock	Evaporated	Rock
Alabama.....	9,745	73,376	10,236	87,587
Arizona.....	11,771	3,298	14,101	3,864
Arkansas.....	7,625	54,026	15,742	54,743
California.....	309,702	29,913	342,188	49,249
Colorado.....	41,880	38,506	37,388	45,236
Connecticut.....	16,335	11,246	14,342	11,090
Delaware.....	3,680	9,080	4,559	8,745
District of Columbia.....	5,206	1,954	5,541	2,194
Florida.....	8,987	26,599	8,453	31,161
Georgia.....	20,107	55,227	19,626	62,390
Idaho.....	21,196	1,148	16,948	1,338
Illinois.....	272,041	218,684	260,284	213,794
Indiana.....	94,637	67,238	88,555	67,956
Iowa.....	131,869	110,071	122,466	105,542
Kansas.....	61,604	174,363	65,272	153,498
Kentucky.....	35,298	73,473	32,859	104,684
Louisiana.....	6,664	118,776	6,028	115,776
Maine.....	12,053	38,781	16,276	39,210
Maryland.....	33,371	64,865	37,742	57,168
Massachusetts.....	53,645	62,250	54,024	59,824
Michigan.....	405,738	58,287	406,373	47,869
Minnesota.....	125,767	75,910	116,766	71,012
Mississippi.....	4,052	30,904	13,723	30,738
Missouri.....	88,900	74,827	73,187	83,578
Montana.....	22,404	2,858	21,399	2,487
Nebraska.....	60,296	60,567	64,029	71,591
Nevada.....	57,253	79,715	11,894	113,305
New Hampshire.....	5,268	48,989	4,551	46,696
New Jersey.....	92,242	177,793	97,638	189,041
New Mexico.....	12,956	12,335	9,997	17,465
New York.....	212,753	478,726	220,224	470,426
North Carolina.....	55,637	51,061	57,839	46,523
North Dakota.....	12,364	4,445	14,318	5,044
Ohio.....	215,467	109,245	203,466	116,115
Oklahoma.....	31,564	39,708	32,236	39,347
Oregon.....	36,582	456	37,898	192
Pennsylvania.....	159,040	115,126	147,566	116,637
Rhode Island.....	9,855	11,274	9,530	9,717
South Carolina.....	11,393	18,241	9,739	18,081
South Dakota.....	22,406	20,614	22,057	19,617
Tennessee.....	31,311	53,172	31,401	50,778
Texas.....	579,232	187,900	566,273	243,388
Utah.....	26,261	3,806	26,234	3,470
Vermont.....	5,433	9,854	5,608	11,838
Virginia.....	55,311	79,120	55,606	84,973
Washington.....	139,685	562	154,960	678
West Virginia.....	169,298	79,871	165,132	80,776
Wisconsin.....	128,591	27,784	109,922	29,241
Wyoming.....	9,026	3,956	14,784	2,762
Other ¹	50,694	119,098	65,641	159,864
	3,993,899	3,250,138	3,942,621	3,448,238

¹ Includes salt used in Puerto Rico (evaporated salt); exports to Africa, Canada, Central America, Cuba, Mexico, Newfoundland, South America, West Indies, and other countries; shipments to Alaska, Hawaii and Puerto Rico; and some shipments to unspecified destinations.

Salt shipped to noncontiguous Territories of the United States, 1943-44

Territory	1943		1944	
	Short tons	Value	Short tons	Value
Alaska.....	3,168	\$73,160	3,211	\$75,157
American Samoa.....	1	67	9	316
Hawaii.....	1,905	42,854	4,419	126,977
Puerto Rico.....	1,684	68,723	2,806	98,654
Virgin Islands.....	75	5,042	90	4,073

PRESENT AND POSTWAR USES

The broad uses of the three categories of salt are shown in the accompanying table. Chemical manufacture requires the largest part of total salt. It consumed all the salt of brine and about 35 percent of the dry salt produced in the United States in 1944.

Salt sold or used by producers in the United States, 1943-44, by classes and uses, in short tons

Use	1943			1944		
	Evapo- rated	Rock	Brine	Evapo- rated	Rock	Brine
Chlorine, bleaches, chlorates, etc.....	1,138,691	770,620	748,982	1,141,408	806,010	917,931
Soda ash.....	2	110	7,157,534	104	104	7,339,996
Dyes and organic chemicals.....	54,772	78,529	67,116	46,114	46,114	---
Soap (precipitant).....	37,717	15,974	54,218	22,402	22,402	---
Other chemicals.....	131,674	376,376	(1)	98,260	414,233	(1)
Textile processing.....	39,705	81,954	40,171	81,247	81,247	---
Hides and leather.....	103,728	191,014	97,506	147,819	147,819	---
Meat packing.....	459,693	375,815	426,271	373,816	373,816	---
Fish curing.....	32,724	53,463	35,998	67,844	67,844	---
Butter, cheese, and other dairy products.....	108,740	9,920	105,174	9,503	9,503	---
Canning and preserving.....	137,532	13,149	146,182	13,210	13,210	---
Other food processing.....	205,548	16,841	206,150	17,424	17,424	---
Refrigeration.....	31,841	179,152	39,575	196,353	196,353	---
Livestock.....	625,675	232,730	550,975	213,999	213,999	---
Highways, railroads, dust, and ice control.....	12,912	283,131	9,300	218,903	218,903	---
Table and other household.....	480,682	184,843	436,323	166,292	166,292	---
Water treatment.....	174,460	200,018	(1)	184,427	184,427	(1)
Agriculture.....	46,127	16,455	53,622	11,156	11,156	---
Metallurgy.....	43,794	31,099	35,741	30,375	30,375	---
Other uses ¹	127,982	147,945	56,599	427,007	427,007	68,383
	3,993,899	3,259,138	7,961,115	3,942,621	3,448,238	8,326,312

¹ Included under "Other uses."

² Includes also exports where use is not specified.

Compared with 1943, considerably increased quantities of both evaporated and rock salt were consumed in 1944 for chlorine, soap precipitant, fish curing, refrigeration, canning and preserving, other food processing, and "other" uses, and decreased quantities for hides and leather, meat packing, dairy products, livestock, highways, table and other household, water treatment, and metallurgy.

Part of the decrease in salt used for table and other household purposes is more apparent than real, as some of the salt shown under "other" uses for 1944 includes exports of salt of a type that could be used for the purposes for which table salt is sold. Table salt required packaging; none of it is sold in bulk. The scarcity of both paper and cloth containers that has been felt increasingly in the past several

years became acute in 1944, and this slowed down production appreciably of that particular type of salt in some sections of the country.

During 1944, the United States Government purchased a large quantity of salt for the Army and Navy for food and medicinal purposes, in addition to large purchases of the salt derivatives, chlorine, soda ash, and caustic soda. As in the last several years, Government purchases of the heavy chemicals reduced the supply for civilian markets. Despite shortage for nonmilitary uses that will be increasingly relieved as the war diminishes, it seems probable that total postwar consumption will fall considerably below the requirements of the past few years. Chlorine producers are concerned over future markets and have been doing a great deal of research for new outlets.

Increased production of synthetic rubber required larger quantities of salt. Exclusive of the chlorine so used, about 140,000 short tons of salt were employed in rubber manufacture in 1944, compared with 66,000 tons in 1943. Its manufacture has become an important industry. It is reported¹ that synthetic rubber is being produced at the rate of 836,000 long tons a year compared with prewar crude-rubber imports of about 600,000 tons. The future market for salt in this field will depend upon the ability of synthetic rubber to compete with the natural rubber when the latter again becomes available and to some extent also upon the method of manufacture that will be employed.

A new process for making chlorine dioxide, which, as reported,² will overcome many limitations of past methods that produced a chemically unstable product. By the new process, it is claimed, chlorine dioxide gas is easily produced and its range of uses expanded. It is stated that it has already proved to have specific value in bleaching and maturing flour, improving taste in public water supplies, and checking blue mold in citrus fruits; experiments indicate increased yield of penicillin in an atmosphere sterilized with ClO_2 .

Salt is required for chlorine, a basic ingredient of the new insecticide DDT, production of which expanded in 1944. However, except for small quantities released for agricultural and civilian experiments, all of it was produced for direct military uses and for disease control of civilians in liberated countries. According to the findings of various Government agencies, it is expected that there will be a large postwar demand for it. At least half a dozen chemical concerns are producing DDT and chloral—its intermediate—on a large commercial scale. A postwar use contemplated is as an insect spray for homes. It has been found effective in this respect when used as an ingredient in wall paint. By the end of 1944 one large company had reduced its cost 40 percent since July and another plant was producing at a rate of two and a half times the designed capacity.

Exclusive of the quantity of chlorine used for bleaching, salt used in processing textiles and in dyestuffs declined from 255,000 tons in 1943 to about 235,000 in 1944.

Further confirmation of the anticipated postwar demand for textiles, reported in the Yearbook chapter for 1943 may be found in a textile-industry forecast³ in June 1944 that after victory our

¹ Chemical Industries, August 1944, vol. 55, p. 208.

² Woodward, E. R., Petroc, G. A., and Vincent, G. P., A New Process for Making Chlorine Dioxide Chem. Ind., July 1944, pp. 58-61.

³ Nation's Business, When Uniforms Go into Moth Balls: Vol. 32, June 1944, p. 24.

returned demobilized fighting men are expected to buy \$18,000,000 worth of clothes a month over a 3-year period. Already our civilian supplies of textiles are in great need of replenishment. Both sodium and chlorine are necessary ingredients of dyestuffs, and salt is also used to set the colors and to exhaust the dye. Salt also performs other functions in textile manufacture, such as shrinking the material.

Salt is one of the basic materials for ingredients used in rendering fabrics resistant to fire, water, and mildew. A huge yardage of textiles for the armed forces was treated with such coatings in 1944. Early in the war mildew was said to have destroyed one-fifth of all fabrics shipped to the South Pacific. Producers of the coatings developed are looking toward broader civilian application when the war terminates.

Compounds of salt are used in making rayon, which is attaining wider fields of use, although in 1944 it was applied chiefly to war purposes, and civilian use was curtailed.

Thousands of tons of salt were used in 1944 for the production of chlorine in the manufacture of magnesium metal, a slight increase being noted despite curtailment of manufacture. The effect of the decrease doubtless will be more noticeable in 1945. However, producers that supplied salt for this purpose report that other outlets are developing.

Recently the Government confirmed the announcement that the Stauffer Chemical Co. would take over operation of the chlorine and caustic soda plant of Basic Magnesium, Inc., at Las Vegas, Nev.

Following the Government's relaxation of magnesium controls in midyear, producers planned civilian applications and marketing methods for magnesium metal. However, although widespread use of the metal in peacetime commercial and consumer products was predicted, Dr. Willard H. Dow estimated ⁴ that postwar demand would be about one-tenth present capacity; annual capacity has been about 600,000,000 pounds.

On the other hand, the production of sodium metal is increasing. It was produced by two companies in 1944, and a third will go into operation about the middle of 1945. Each ton of sodium produced takes about 2½ tons of salt. About 50,000 tons of salt will be required in 1945 if the planned program materializes.

In addition to the foregoing salt uses, a great variety of others were reported to the Bureau of Mines in 1944, such as its application in ceramics, refractories, oil refining, tobacco, glass, automotive industry, laundry and dry cleaning, coal and coke, brick and tile, pulp and paper, candles, and solvents.

Refrigerating machines that utilize salt are being used to supply a great deal of ice to the armed forces for use in hospitals, to cool water and soft drinks, and to refrigerate food.

Salt was employed as a fertilizer ingredient in 1944, although the total used in the United States is not known. According to a recent report,⁵ a greater use of agricultural salt has alleviated considerably the shortage of potash in the United Kingdom during the war years. It is estimated that a threefold increase has occurred in the consump-

⁴ Chemical and Engineering News, The Future of Magnesium: Vol. 23, Mar. 25, 1945, p. 553.

⁵ Chemical and Engineering News, World Wide Chemistry, United Kingdom, Fertilizers: Vol. 23, Jan. 25, 1945, p. 186.

tion of salt for the purpose in the past 3 years, and the demand for the coming season was expected to be great.

The fact that the United States, despite great exchange of population and overcrowded conditions, has not experienced any serious epidemics that are associated with impure water and unsanitary waste disposal is credited⁶ to the efficient use of chlorine by sanitary engineers.

Another new outlet for a salt compound is a unique process, recently devised, that employs a caustic soda bath to recover aluminum from airplanes, resulting in a high-grade aluminum that may be reprocessed into different forms. As it has been demonstrated to be a decided advance over other methods of recovery of aluminum from unsegregated scrap metals the future of this use for caustic soda appears to be assured.

Many salt mines found by the American and Soviet Armies had been utilized by the Germans as underground factories for making war materials. The most spectacular use of salt mines in 1944, disclosed recently, was the storage by the Germans of millions of dollars worth of gold and treasured works of art; the most notable was that discovered by American soldiers at Merkers.

In reverting to peacetime business, the salt industry will not be confronted with direct problems of a physical or mechanical nature in regard to its mines and plants; its principal problem will be to readjust its distributing mechanism to the changing markets. When the United States entered actively into the war, it was not necessary for salt producers and manufacturers of chemicals—especially heavy chemicals—to change equipment, processes, and procedures; they merely speeded their output and in some instances enlarged their capacity. Many salt plants did not even require capacity expansion because the existing capacity had not been fully used for some years. In the decade 1930–39, it was believed that only about two-thirds of plant capacity was being utilized. Bureau of Mines studies in recent years show that, with much the same equipment, in 1942 rock-salt mines operated at 54 percent and evaporated plants at 80 percent of capacity; in 1943, with some increases in both capacity and production, it was 62 percent of capacity for mines and 76 percent for plants; in 1944, with still further increases in both, it was 64 percent for mines and 53 percent for plants.

Although direct reconversion is unnecessary, both salt and chemical industries will be affected indirectly by cessation of the war inasmuch as numerous industries that use their basic products will have reconversion problems that will involve delay.

On the other hand, certain salt-consuming plants may be converted with little or no delay and with no substantial change in the quantity of salt employed. For instance, a magnesium-metal plant employing chlorine has changed over to metallic sodium manufacture with little modification in equipment or basic process.

Many observers foresee radical economic and industrial changes. It is inevitable that some prewar activities will never be revived and that new adaptations to peacetime, learned during the production for war, will be made, but the salt industry as a whole, except for the

⁶ Industrial and Engineering Chemistry, ind. ed., vol. 36, November 1944, p. 8, in the interpretive digest of chemical industries reports.

transition period of the salt-consuming industries, appears to be in as favorable a position as any of the essential industries and in better position than many. During World War I, great advances were made in the chemical industry in the United States, and additional gains have been made in World War II. During the interwar period the chemical industry never lost the foothold it had obtained in the First World War, and the salt output used for chemical manufacture steadily gained and did not fall below that of prewar years, except for one year: in 1921 it was less than in 1913 and 1914. During the interwar years the United States led in world production of chemicals. There is every reason to believe that, in the coming period, although some lines of business may recede the chemical industry will retain a great part of its wartime gains, and consumption of salt—one of the most important chemical raw materials—will likewise be maintained at a high level.

IMPORTS AND EXPORTS ¹

For a long time exports and imports of salt have been relatively small—hovering around 1 percent of domestic production—the imports having been consistently smaller than the exports.

Salt imported for consumption in the United States, 1943-44, by countries

Country	1943		1944	
	Short tons	Value	Short tons	Value
North America:				
Canada.....	1,256	\$12,621	1,319	\$20,445
Dominican Republic.....	2	129		
West Indies: British Bahamas.....			97	298
Asia: Arabia Peninsula States.....			958	1,916
Africa: Egypt.....			3,180	9,500
	1,258	12,750	5,554	32,159

Salt imported for consumption in the United States, 1943-44, by classes

Year	In bags, sacks, barrels, or other packages (duty-free) ¹		Bulk			
			Duty-free		Free (used in curing fish)	
	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	1,024	\$6,601	16,413	\$59,029	12,965	\$25,174
1941.....	1,110	12,156	6,896	17,021	7,426	30,038
1942.....	367	4,138	953	7,496	6,434	17,667
1943.....	129	2,425	1,129	10,325		
1944.....	14	700	5,540	31,459		

¹ Includes 98 pounds valued at \$3 imported free in 1942, 12,939 pounds valued at \$493 in 1943, and 9,001 pounds valued at \$356 in 1944.

² Includes salt in bags, barrels, or other packages as follows: 1940: 6 tons, \$12; 1942: 122 tons, \$1,200; 1941, 1943, and 1944: None reported.

³ Includes 3,818,644 pounds valued at \$9,244 imported free.

⁴ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Shipments shown in the following table include exports made through lend-lease arrangements:

Salt exported from the United States, 1943-44, by countries

Country	1943		1944	
	Short tons	Value	Short tons	Value
North America:				
Bermuda.....	21	\$1,457	82	\$3,305
Canada.....	79,374	458,430	123,828	609,676
Central America:				
British Honduras.....	484	6,128	568	7,530
Guatemala.....	17	521	17	580
Honduras.....	104	2,663	228	4,296
Nicaragua.....	445	10,713	678	14,383
Panama: Republic of.....	12	775	71	1,725
Greenland.....	3,599	33,175	3,660	33,753
Iceland.....	9	562	10	563
Mexico.....	8,235	147,047	13,017	220,696
Newfoundland and Labrador.....	40,509	253,023	40,336	256,915
West Indies:				
British:				
Barbados.....	325	5,529	414	7,902
Jamaica.....	32	826	1,801	50,391
Trinidad and Tobago.....	40	690	104	1,807
Other British.....	14	979	50	2,229
Cuba.....	9,166	128,901	6,140	84,518
Curacao (N. W. I.).....	160	3,038	312	12,121
Dominican Republic.....	75	3,529	229	9,177
Haiti.....	34	2,187	18	1,089
Other North America.....	8	366	24	1,070
South America:				
Argentina.....	215	2,115	(¹)	17
Brazil.....	182	10,852	2,691	91,895
British Guiana.....	348	7,317	396	8,046
Colombia.....	2	469	1	400
Surinam.....	202	4,233	370	9,421
Other South America.....	12	1,717	68	2,313
Europe:				
Gibraltar.....	26	4,093		
U. S. S. R.....	480	28,347	325	24,800
Other Europe.....	1	206	(¹)	1
Asia:				
Arabia Peninsula States.....	(¹)	2	10	767
India and Dependencies.....	(¹)	77	7	394
State of Bahrain.....	1	62	14	484
Other Asia.....			3	441
Africa:				
Algeria.....	126	9,075	(¹)	14
Liberia.....	1,233	33,688	2,151	66,619
Union of South Africa.....	5	530	484	23,046
Other Africa.....	45	3,568	75	3,353
Oceania:				
British:				
Australia.....	3	243	1	51
New Zealand.....	8	403	2	56
Other British.....			1	20
French.....	251	5,603	182	4,312
	145,803	1,173,139	198,368	1,620,176

¹ Less than 1 ton.

WORLD PRODUCTION

Reports to the Bureau of Mines contain information on salt in foreign countries in 1944, including: Argentina's control of its salt exports; Brazil's decree regarding duty-free salt, a plan to develop new salt wells near Aracaju, State of Sergipe, to establish a sodium chemical products industry employing the Solvay process, and another to develop a soda-ash and caustic soda industry utilizing salt from sea water at Cabo Frio, as soon as machinery can be obtained; Canada's utilization of salt in making certain heavy chemicals, hoping to retain in the postwar period a large part of its gains made in the chemical industry during the war; Chile's salt exports (in 1944, it planned

a future salt and chemical industry); China's salt production in three northwest Provinces; Colombia's salt resources and plans for developing a salt industry; Guatemala's decree dissolving the salt producers' pool; Mexico's salt deposits brought under the general mining law and Federal concessions now granted for production of salt as with other minerals; and Peru's salt deposits and industry.

Government restrictions on publication of statistics for many foreign countries have been relaxed, and the following table supplies figures heretofore lacking for several years past:

World production of salt, 1938-44, by countries, in metric tons ¹

[Compiled by B. B. Waldbauer]

Country ¹	1938	1939	1940	1941	1942	1943	1944
North America:							
Canada.....	398, 013	385, 550	420, 974	510, 930	501, 343	619, 528	650, 335
Costa Rica.....	4, 740	6, 822	(?)	6, 000	7, 727	3, 414	6, 197
Dominican Republic....	9, 286	9, 536	7, 500	14, 700	5, 560	12, 630	11, 300
Guatemala.....	10, 465	(?)	(?)	(?)	11, 600	12, 440	12, 466
Honduras.....	(?)	(?)	(?)	(?)	3, 400	2, 500	2, 700
Mexico.....	107, 701	(?)	(?)	(?)	584, 000	744, 000	(?)
Nicaragua.....	(?)	(?)	(?)	(?)	6, 000	6, 000	(?)
Panama.....	3, 332	4, 536	5, 199	(?)	9, 526		10, 000
United States:							
Rock salt.....	1, 725, 330	1, 846, 254	2, 055, 260	2, 575, 983	2, 542, 179	2, 966, 625	3, 128, 173
Other salt.....	5, 555, 486	6, 570, 481	7, 843, 089	9, 163, 917	9, 890, 064	10, 845, 349	11, 130, 121
West Indies:							
British:							
Bahamas.....	17, 900	11, 600	27, 000	25, 400	6, 170	790	60, 980
Turks and Caicos Islands (exports).....	35, 578	47, 389	67, 028	48, 179	15, 561	8, 512	33, 779
Cuba.....	57, 970	113, 398	113, 398	41, 900	43, 545	18, 416	15, 422
Haiti.....	6, 000	12, 600	10, 500	2, 100	(?)	8, 000	8, 000
Netherlands (exports).....	2, 013	247	37	3, 226	4, 574	4, 792	5, 180
South America:							
Argentina:							
Rock salt.....		700	350	800	355	(?)	(?)
Other salt.....	264, 150	303, 321	292, 307	372, 689	364, 279	(?)	(?)
Brazil.....	780, 144	564, 330	398, 538	580, 000	598, 537	416, 121	453, 001
Chile.....	27, 772	39, 593	44, 317	57, 185	55, 578	37, 111	(?)
Colombia:							
Rock salt.....	4, 010	3, 950	4, 703	4, 530	4, 816	(?)	(?)
Other salt (estimate).....	84, 000	101, 400	105, 100	79, 400	103, 926	(?)	(?)
Ecuador:							
Rock salt.....			(?)		(?)	(?)	(?)
Other salt.....	13, 800	16, 145	29, 900	20, 207	24, 893	11, 947	35, 938
Peru.....	38, 451	39, 669	41, 326	46, 855	45, 838	49, 027	50, 634
Venezuela.....	22, 658	20, 473	52, 540	40, 193	17, 637	33, 836	(?)
Europe:							
Bulgaria:							
Rock salt.....	10, 242	13, 168	15, 000	(?)	(?)	(?)	(?)
Other salt.....	66, 258	(?)	65, 000	(?)	(?)	(?)	(?)
Czechoslovakia.....	174, 000	(?)	(?)	(?)	(?)	(?)	(?)
France:							
Rock salt and salt from springs.....	1, 264, 230	(?)	(?)	(?)	(?)	(?)	(?)
Other salt.....	346, 046	(?)	(?)	(?)	(?)	(?)	(?)
Germany:							
Rock salt.....	2, 694, 984	(?)	(?)	(?)	(?)	(?)	(?)
Other salt.....	585, 326	(?)	(?)	(?)	(?)	(?)	(?)
Austria:							
Rock salt.....	786	(?)	(?)	(?)	(?)	(?)	(?)
Other salt.....	93, 576	(?)	(?)	(?)	(?)	(?)	(?)
Greece.....	102, 057	(?)	(?)	(?)	(?)	(?)	(?)
Italy:							
Rock salt.....	613, 870	682, 589	(?)	(?)	(?)	(?)	(?)
Other salt.....	885, 205	682, 519	(?)	(?)	(?)	(?)	(?)
Malta.....	1, 523	1, 753	(?)	(?)	(?)	(?)	(?)
Netherlands: Rock salt.....	164, 266	(?)	(?)	(?)	(?)	(?)	(?)
Poland.....	642, 875	(?)	(?)	(?)	(?)	(?)	(?)
Portugal:							
Rock salt.....					(?)	73	(?)
Other salt.....	4, 096	4, 289	11, 955	6, 951	747	669	(?)
Rumania:							
Rock salt.....	350, 618	(?)	(?)	(?)	280, 088	363, 151	(?)
Other salt.....	1, 140	(?)	(?)	(?)			(?)

See footnotes at end of table.

World production of salt, 1938-44, by countries, in metric tons ¹—Continued

Country ¹	1938	1939	1940	1941	1942	1943	1944
Europe—Continued.							
Spain:							
Rock salt	150,878	157,784	206,650	195,686	248,302	266,226	(?)
Other salt	102,671	661,269	463,795	358,217	405,665	500,392	(?)
Switzerland:	84,049	90,000	77,000	67,000	71,000	74,000	72,000
United Kingdom:							
Great Britain:							
Rock salt	19,974	(?)	(?)	(?)	(?)	(?)	(?)
Other salt	2,651,939	(?)	(?)	(?)	(?)	(?)	(?)
Ireland, Northern:							
Rock salt	2,362	(?)	(?)	(?)	(?)	(?)	(?)
Other salt	6,787	10,740	13,948	13,607	13,499	11,183	(?)
Yugoslavia:	52,634	54,213	(?)	(?)	² 28,000	(?)	(?)
Asia:							
Aden:	282,510	294,077	258,714	181,873	70,107	202,434	208,603
Burma:	39,319	(?)	(?)	(?)	(?)	(?)	(?)
Ceylon:	36,490	37,556	29,973	23,271	19,572	13,761	³ 26,570
China (including Manchuria):	⁴ 3,000,000	⁴ 3,000,000	⁴ 3,000,000	⁴ 1,152,000	⁴ 780,000	(?)	(?)
Chosen ⁵:	138,000	138,000	138,000	(?)	(?)	(?)	(?)
Cyprus ⁶:	3,000	3,000	3,000	(?)	(?)	(?)	(?)
India:							
British:							
Rock salt	191,395	196,503	207,294	195,890	219,481	332,843	(?)
Other salt	1,372,979	1,326,544	448,598	1,611,640	1,702,845	1,624,977	(?)
Portuguese:	29,527	27,979	38,564	⁴ 10,070	⁴ 13,672	⁴ 10,290	19,144
Indochina:	193,050	213,526	166,000	(?)	(?)	(?)	(?)
Iraq:	7,907	9,107	8,331	10,303	11,604	21,356	(?)
Netherlands Indies:	90,909	⁷ 141,208	⁸ 388,837	(?)	(?)	(?)	(?)
Palestine:							
Rock salt	444	645	599	576	1,886	1,822	(?)
Other salt	8,065	8,736	9,944	10,965	10,705	17,955	(?)
Syria ⁹:	10,000	10,000	10,000	(?)	(?)	(?)	(?)
Thailand (exports):	156,268	95,170	112,197	(?)	(?)	(?)	(?)
Turkey:							
Rock salt	18,485	(?)	19,621	22,350	22,105	22,976	(?)
Other salt	228,808	(?)	193,213	173,896	202,861	243,353	(?)
Africa:							
Algeria:	74,630	(?)	(?)	68,376	68,376	25,488	(?)
Belgian Congo:	1,013	(?)	1,038	1,159	1,191	(?)	(?)
British Somaliland:	363	(?)	(?)	(?)	(?)	(?)	(?)
Canary Islands ¹⁰:	2,000	2,000	2,000	(?)	(?)	(?)	(?)
Egypt (exports):	284,949	442,532	206,211	155,123	100,716	(?)	(?)
Ethiopia: Rock salt ¹¹:	10,000	10,000	10,000	(?)	(?)	(?)	(?)
French West Africa ¹²:	(?)	(?)	(?)	(?)	40,000	45,000	53,000
Kenya Colony:	3,250	(?)	9,425	14,179	13,694	15,318	14,051
Libya (Italian Africa):							
Cyrenaica ¹³ :	10,000	10,000	10,000	(?)	(?)	(?)	(?)
Tripolitania ¹⁴ :	20,000	20,000	20,000	(?)	(?)	(?)	(?)
Mauritius ¹⁵:	1,500	1,500	1,500	(?)	(?)	(?)	(?)
Morocco, French:							
Rock salt	909	1,400	1,546	6,587	10,934	12,208	(?)
Other salt	(?)	13,400	23,605	27,150	32,968	31,963	(?)
Nigeria ¹⁶:	400	400	400	(?)	(?)	(?)	(?)
Portuguese East Africa:	6,448	6,628	251	7,506	2,562	379	(?)
Portuguese West Africa (Angola):	¹⁷ 25,000	22,970	29,148	40,305	45,145	43,419	37,652
Somaliland, Italian:	186,000	146,000	(?)	(?)	(?)	(?)	(?)
South-West Africa:							
Rock salt	641	751	1,125	1,654	2,090	2,096	3,123
Other salt	4,431	4,704	5,364	7,811	8,314	8,616	9,016
Sudan, Anglo-Egyptian:	37,532	40,633	40,471	40,668	39,630	40,488	35,969
Tanganyika Territory:	9,678	9,472	9,505	(?)	(?)	(?)	(?)
Tunisia:	129,297	106,310	122,267	107,667	(?)	(?)	(?)
Uganda:	3,169	2,626	3,374	4,314	4,212	5,243	(?)
Union of South Africa:	117,717	(?)	(?)	(?)	(?)	(?)	(?)
Oceania:							
Australia:							
South Australia	76,013	80,759	146,991	173,431	176,972	187,270	(?)
Western Australia	3,850	(?)	(?)	(?)	(?)	(?)	(?)

¹ In addition to the countries listed salt is produced in Albania, Bolivia, Eritrea, French Somaliland, Gold Coast, Japan, Leeward Islands, Madagascar, Philippine Islands, Southern Rhodesia, Taiwan, U. S. S. R., and Victoria (Australia), but figures of production are not available.

² Data not available.

³ Estimate.

⁴ Exports.

⁵ January to June, inclusive (Croatia only).

⁶ Unoccupied China.

⁷ January to September, inclusive.

⁸ Incomplete data.

MAGNESIUM COMPOUNDS AND MISCELLANEOUS SALINES

By CHARLES L. HARNES AND F. M. BARSIGIAN¹

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SUMMARY

Demand for magnesite for use in basic refractories was high in 1944, although slightly less than in 1943. Reduction in output of magnesium metal closed the magnesite flotation unit of Basic Magnesium, Inc., at Gabbs, Nev., late in 1944, which contributed heavily to the 26-percent drop in production of uncalcined magnesite in 1944 as compared with 1943. Mineral sources other than magnesite that provided magnesia were sea water, well brines, brucite, and dolomite. On the whole, salines showed improvement. Sales of natural calcium chloride, used mostly in road stabilization, increased slightly. Iodine output, however, was lower, owing to accumulation of Chilean stocks in this country. Antiknock requirements for military motor fuels continued active and necessitated a greater output of bromine to make ethylene dibromide. Despite accumulating stocks and labor shortages in certain areas, production of natural sodium sulfate increased 5 percent. West-coast demand for sodium carbonates in cleansers, glass, and metallurgy increased also. Sales of sodium borates, stimulated by increased demands in glassmaking, likewise were higher in 1944.

Part I.—MAGNESIUM COMPOUNDS

MAGNESITE

Magnesite production was higher in 1944 than during any year except 1943. The substantial decline from the high level of 1943 resulted from the closing of the Basic Magnesium, Inc., magnesite flotation plant at Gabbs, Nev., late in the year, owing to cut-backs in the magnesium-metal program. Labor shortages forced a virtual shut-down of the Western mine of Westvaco Chlorine Products Corp., near Livermore, Calif.; this mine supplies a dense grade of brick-making periclase difficult to procure elsewhere. On the other hand, Northwest Magnesite Co., at Chewelah opened another quarry for the production of maintenance and brick-making grades of magnesia. Re-

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

fractory demands were heavy, though less than in 1943. Caustic-calcined magnesite declined in demand somewhat, probably owing to reduced use in marine oxychloride cement flooring. Requirements of caustic-calcined magnesia for use in fertilizers, epsom salt, and rubber remained high.

Salient statistics of the magnesite industry in the United States, 1940-44

	1940	1941	1942	1943	1944
Crude:					
Mined: ¹					
Short tons.....	333, 166	374, 799	497, 368	754, 832	561, 450
Value.....	\$2, 487, 969	\$2, 655, 547	\$3, 874, 334	\$6, 071, 596	\$4, 407, 461
Sold by producers:					
Short tons.....	2, 133	4, 536	6, 835	4, 090	(7)
Value.....	\$32, 810	\$54, 045	\$57, 350	\$47, 788	(1)
Average per ton ²	\$15. 38	\$11. 91	\$8. 39	\$11. 68	(2)
Imports for consumption:					
Short tons.....	22				1, 039
Value.....	\$761				\$24, 588
Caustic-calcined magnesia:					
Sold or used by producers: ³					
Short tons.....	16, 261	30, 225	41, 889	191, 792	139, 243
Value.....	\$512, 607	\$1, 052, 077	\$2, 028, 126	\$11, 497, 505	\$6, 481, 963
Average per ton ²	\$31. 52	\$34. 81	\$48. 42	\$59. 95	\$46. 55
Imports for consumption:					
Short tons.....	928	864	578	290	559
Value.....	\$21, 301	\$23, 972	\$19, 105	\$13, 122	\$15, 286
Refractory magnesia:					
Sold or used by producers: ³					
Short tons.....	140, 668	201, 481	273, 661	301, 382	278, 490
Value.....	\$2, 802, 537	\$5, 052, 879	\$7, 823, 963	\$9, 341, 183	\$8, 426, 049
Average per ton ²	\$19. 92	\$25. 08	\$28. 50	\$30. 99	\$30. 26
Imports for consumption:					
Short tons.....	30, 951	36, 791	7, 728	9, 233	6, 176
Value.....	\$551, 536	\$824, 068	\$280, 342	\$310, 497	\$260, 062

¹ Partly estimated; most of the crude is processed by the mining companies, and very little enters open market.

² Bureau of Mines not at liberty to publish figures.

³ Average receipts f. o. b. mine shipping point.

1940-41: Includes caustic-calcined magnesite and caustic-calcined magnesia from sea-water bitters; 1942-44: Includes caustic-calcined magnesite and reactive magnesia from sea-water bitters, well brines, and raw sea water and from precipitated magnesium carbonate obtained from dolomite.

¹ 1940: Includes dead-burned magnesite and refractory magnesia from sea-water bitters; 1941: Includes dead-burned magnesite and refractory magnesia from brucite, dolomite, and sea-water bitters; 1942-43: Includes dead-burned magnesite and refractory magnesia from brucite, dolomite, sea-water bitters, well brines, and raw sea water; 1944: Includes dead-burned magnesite and refractory magnesia from brucite, dolomite, sea-water bitters, and raw sea water.

Magnesia sold or used by producers in the United States, 1943-44, by kinds and sources

[Quantities and values reported apply to finished products, not raw materials]

Finished product	From magnesite		From brucite, dolomite, and sea-water bitters		From well brines and raw sea water	
	Short tons	Value	Short tons	Value	Short tons	Value
1943						
Caustic-calcined.....	137, 300	\$7, 941, 587	8, 649	\$547, 883	45, 843	\$3, 008, 030
Refractory.....	185, 992	4, 426, 152	89, 283	3, 664, 258	26, 107	1, 250, 773
	323, 292	12, 367, 739	97, 932	4, 212, 146	71, 950	4, 258, 803
1944						
Caustic-calcined.....	97, 933	4, 033, 759	11, 129	759, 288	30, 181	1, 688, 916
Refractory.....	152, 802	3, 217, 714	87, 539	3, 537, 561	38, 149	1, 670, 774
	250, 735	7, 251, 473	98, 668	4, 296, 849	68, 330	3, 359, 690

Magnesite imported for consumption in the United States, 1942-44, by countries

CRUDE MAGNESITE

Country	1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value
Cuba.....					47	\$857
U. S. S. R.....					992	33,731
					1,039	34,588

LUMP CAUSTIC-CALCINED MAGNESITE

Canada.....					3	\$82
Cuba.....	412	\$12,829	174	\$7,497		
India and Dependencies.....					551	14,748
United Kingdom ¹					5	456
	412	12,829	174	7,497	559	15,286

GROUND CAUSTIC-CALCINED MAGNESITE

Canada.....	100	\$3,454				
Cuba.....	59	2,126	106	\$4,750		
United Kingdom ¹	7	696	10	875		
	166	6,276	116	5,625		

DEAD-BURNED AND GRAIN MAGNESITE AND PERICLASE

Canada.....	425	\$41,491	147	\$14,319	780	\$76,263
U. S. S. R.....	6,723	219,137	9,086	296,178	5,396	163,799
United Kingdom ¹	580	19,714				
	7,728	280,342	9,233	310,497	6,176	260,062

¹ United Kingdom of Great Britain and Northern Ireland.

The use of basic ramming mixes continued at high levels in 1944. The relative merits of a furnace lining built up from dead-burned magnesite, a layer at a time, and a furnace lining of a rammed magnesia grain are still to be decided, but wartime practice definitely favors rammed bottoms, owing to the speed with which they can be installed.

Rapid repair methods have been refined further so that shut-downs between heats are minimized. "Gun repair" has achieved considerable success; this method has been defined as "the forceful emplacement by compressed air of suitably compounded and moistened basic refractory through a hot furnace and on to the hot wall or structure to be repaired."²

Schoenlaub³ and Nicholas⁴ described the use of gun mixtures some as follows: The mix may be applied at temperatures up to about 2,200° F., and it is recommended that application follow the addition of scrap; the fuel supply may be maintained in the furnace, and no furnace time is lost. Two types of guns are used—one that adds water at the nozzle to a dry feed, and another that uses a slurry feed. Various refractories may be used, such as magnesite, chrome-dolomite, and forsterite, but there are certain requisites to be observed in for-

² Schoenlaub, R. A., Gunmix: Proc., Open Hearth Conf., Am. Inst. Min. and Met. Eng., vol. 27, 1944, p. 326.³ Schoenlaub, R. A., Work cited in footnote 2, p. 326.⁴ Nicholas, I. A., Gun Mixtures: Proc., Open Hearth Conf., Am. Inst. Min. and Met. Eng., vol. 27, 1944, pp. 331-332.

mulating the mix. The material must be very adhesive when wet, so that it will not bounce from the furnace wall, even when the wall is smooth. The refractory must not be disrupted by the steam generated as it passes through the furnace atmosphere and when it strikes the hot wall. The refractory must withstand a high temperature and must, of course, remain attached during subsequent service subject to normal wear.

Experiments with basic roofs continue, the goal being a roof that will permit higher furnace temperatures with consequent lower fuel consumption and faster steel making. Heuer⁶ points out other advantages:

The elimination of all silica brick above the floor line of the furnace will effect substantial reduction in the amount of silica that must be taken out of the furnace in the slag. This will cause reduction in the slag-making materials that must be added. Substantial reduction in the amount of maintenance materials for the walls and banks of the furnace should also result.

The temperature required to maintain a low-carbon steel for pouring is about 2,880° F., and the temperature at which silica brick in contact with iron oxide begins to soften is about 3,000° F. Commercial magnesia brick are available that will withstand 3,400° F. Despite this temperature advantage over silica brick, the latter are used in the roofs and parts of the walls of the standard open hearth, because silica brick is stronger under load, does not undergo excessive volume change with change in temperature, as does magnesia brick, and is more resistant to FeO than magnesia. Also, magnesia brick spalls notoriously with fluctuating temperatures, particularly below 2,000° F., whereas silica is little affected by temperature changes above 1,200° F.

In installing a basic roof, it is immediately obvious that the sprung arch used with silica roofs will be useless with magnesia brick, for magnesia brick cannot support loads at steel-making temperatures. A suspended roof with expansion joints has been recommended. Construction of a basic roof using burned and unburned brick has been described by Frank.⁶ After about 100 heats, the unburned brick was found to have spalled considerably, whereas the burned brick showed no spalling. It was planned to replace the spalling unburned brick with burned brick.

Magnesium oxychloride cement unjustly gained an unsavory reputation in the 1920's when attempts were made to use it in exterior stuccos without knowledge of how it should be applied. The rains came, and many poorly formulated stuccos had to be replaced. Since that time, interest in oxychloride cements has gradually recovered, and contractors are using plastic magnesia with a better knowledge of its limitations as well as its valuable flooring properties. Graf⁷ has described modern usage, and his discussion is summarized as follows:

Oxychloride cement floors may be laid over old or new floors or subbases. The floors are permanent, warm, quiet, resilient, dustproof, relatively nonslip, incombustible, inhibiting to bacteria and fungi, and have good wearing qualities. Because of its inherent resilience, magnesium oxychloride may be applied monolithically to large areas without cracking, provided there is no excessive structural

⁶ Heuer, R. P., Development of Basic Open-Hearth Roofs: Proc., Open Hearth Conf., Am. Inst. Min. and Met. Eng., vol. 27, 1944, p. 338.

⁶ Frank, H. S., Installation of Basic Open-Hearth Roof: Proc., Open Hearth Conf., Am. Inst. Min. and Met. Eng., vol. 27, 1944, pp. 334-337.

⁷ Graf, D., Plastic Magnesium Oxychloride Flooring: Pencil Points, vol. 25, No. 9, September 1944, pp. 91-92.

movement, or to smaller areas if strains are present. This property has led to its widespread use in ships and street, railway, and subway cars, where the vibration and racking impose serious demands. The material is furnished to the site of application in two parts. The first consists of magnesium oxide, aggregates, colors, and fillers which have been mixed in dry form by the installer. The second is magnesium chloride, which is furnished in flake form and is reduced to a liquid on the job by the addition of water to the required specific gravity. These are mixed into a mortar which is spread, leveled, and finished by troweling or grinding. The cost of $\frac{1}{4}$ -inch flooring may be as low as 25 cents a square foot. Costs increase with freight rates, use of special ingredients, small installations, and other factors.

On July 1, 1944, the Oxychloride Cement Association was formed, with offices at 1010 Vermont Avenue NW., Washington 5, D. C., representing Dow Chemical Co. (supplier of magnesium chloride), Westvaco Chlorine Products Corp. (supplier of lump caustic-calcined magnesia), and F. E. Schundler & Co. (grinder of the magnesia supplied by Westvaco).

PRICES

Prices of magnesite and calcined magnesia were virtually the same in 1944 as in the previous year. Very little crude magnesite is sold on the open market, and prices, which ranged from \$10 to \$15 a short ton in 1944, depend to a considerable degree on negotiation. Dead-burned grain magnesite, as sold by Northwest Magnesite Co., remained at \$22 a short ton f. o. b. Chewelah, Wash. There has been very little fluctuation in the price since 1928. Prices for the mined and synthetic magnesias of Westvaco Chlorine Products Corp. were unchanged in 1944, except that prices for mined periclase were nominal when this commodity was taken off the market later in the year. Following is a price schedule of representative magnesias sold by this firm in 1944 (carlots, f. o. b. California): Caustic-calcined magnesite, bulk—\$52.75, powdered—\$58.75; calcined (sea-water) magnesia, bulk—\$54, powdered—\$60; mined periclase, bulk, 85 percent—\$38.24, 90 percent—\$40.50; sea-water periclase, bulk, 85 percent—\$36.00, 90 percent—\$36.50.

REVIEW BY STATES

California.—Johns-Manville Products Corp., 22 East Fortieth Street, New York 16, N. Y., produced 85-percent magnesia insulation from purchased magnesite at its Redwood City (Calif.) plant. Marine Magnesium Products Corp., South San Francisco, Calif., the pioneer producer of magnesia from sea water, continued its output of high-grade magnesium oxides and hydroxide in 1944. Permanente Cement Co., Permanente, Calif., had no output of calcined magnesite in 1944 but sold small quantities from inventory. Permanente Metals Corp., Permanente, Calif., operated its Moss Landing (Calif.) plant at near capacity levels, recovering magnesium oxide from raw sea water and dolomite for use in making magnesium metal and refractories and for other purposes. Plant Rubber & Asbestos Works, 537 Brannan Street, San Francisco, Calif., produced 85-percent magnesia insulation from its plants at Emeryville and Redwood City, Calif., using purchased magnesium hydroxide and magnesite as raw materials in the respective plants. Westvaco Chlorine Products Corp., Newark, Calif., closed its Western magnesite mine at Livermore in the latter part of the year except to supply a little raw magnesite to manufacturers of magnesia insulation; the firm operated its Bald Eagle magnesite mine at Gustine, Calif., and recovered magnesium oxide from sea-

water bitterns at Newark for use in making periclase, in oxychloride cement, as a rubber catalyst, as a fertilizer, in epsom salts, and in various specialty uses.

Georgia.—International Minerals & Chemical Corp., 20 North Wacker Drive, Chicago 6, Ill., recovered magnesium sulfate from serpentine at its Augusta (Ga.) plant for use in fertilizers, tanning, and making rayon.

Illinois.—Johns-Manville Products Corp., 22 East Fortieth Street, New York 16, N. Y., produced 85-percent magnesite from dolomite at its Waukegan (Ill.) plant.

Louisiana.—Mathieson Alkali Works, Inc., 60 East Forty-second Street, New York 17, N. Y., recovered magnesium chloride from dolomite and ammonia-soda waste liquors at a Defense Plant Corporation installation at Lake Charles, La. The plant was shut down early in 1944 owing to reduced requirements for magnesium metal.

Michigan.—Dow Chemical Co. recovered magnesium chloride and epsom salt from well brines at Midland, Mich. Dow Magnesium Corp., Midland, Mich., recovered magnesium chloride from rich well brines at Ludington, Mich., for conversion to metal at the Marysville plant of the Defense Plant Corporation. Michigan Chemical Co., St. Louis, Mich., produced caustic-calcined magnesite from dolomite and well brines largely for use in the fertilizer, rayon, and rubber industries. Morton Salt Co., 310 South Michigan Avenue, Chicago, Ill., produced precipitated magnesium carbonate at Manistee, Mich., largely for coating salt grains.

Nevada.—The largest single producer of magnesite in the country—Basic Magnesium, Inc.—banked its furnaces October 1, 1944, owing to cut-backs in magnesium-metal requirements. This mammoth venture has provided much technical information, some of which appeared in print in 1944.⁸ Basic Refractories, Inc., 845 Hanna Building, Cleveland 15, Ohio, mined brucite at Gabbs, Nev., for shipment to Maple Grove, Ohio, where it is made into well-known proprietary basic refractories, including ramming mixes, surfacers, and specialties. Sierra Magnesite Co., owned jointly by Westvaco Chlorine Products Corp. and Henry J. Kaiser and affiliates, continued production at Gabbs, Nev., in 1944.

New Jersey.—Johns-Manville Products Corp., 22 East Fortieth Street, New York 16, N. Y., produced 85-percent magnesite insulation from dolomite at its Manville (N. J.) plant. The Cape May (N. J.) plant of Northwest Magnesite Co., 1800 Farmers Bank Building, Pittsburgh, Pa., recovered magnesite from sea water continuously in 1944 for use in basic refractories.

New Mexico.—International Minerals & Chemical Corp., Carlsbad, N. Mex., recovered byproduct magnesium chloride from its potash operations for conversion to metal at Austin, Tex.

Ohio.—Diamond Alkali Co., Oliver Building, 535 Smithfield Street, Pittsburgh, Pa., made magnesium chloride from dolomite at Paines-

⁸ Parker, J. L., Open-Pit Mining of Magnesite Ore: The Explosives Eng., vol. 23, No. 1, January-February 1945, pp. 9-11, 31.

Mining World, Magnesite Mining at Gabbs: Vol. 6, No. 11, November 1944, pp. 23-26.

Weinig, A. J., assr. to Basic Magnesium, Inc., of the following United States patents issued Nov. 21, 1944: Treatment of Magnesite Ores, No. 2,363,029; Flotation of Magnesite, No. 2,363,030; Froth Flotation Treatment of Low Grade Magnesite Ores, No. 2,363,031; and Magnesite Ore Treatment, No. 2,363,104, Nov. 21, 1944.

ville, Ohio, for conversion to magnesium metal. The process has been described by Avery and Evans.⁹

Pennsylvania.—Ehret Magnesia Manufacturing Co., Valley Forge, Pa., produced 85-percent magnesia insulation from dolomite. General Magnesite & Magnesia Co., Venango and Balfour Streets, Philadelphia, Pa., calcined precipitated magnesium carbonate to yield a high-grade magnesia. Keasbey & Mattison Co., Butler Avenue and Maple Street, Ambler, Pa., produced 85-percent magnesia and high-grade magnesium oxide from dolomite. The Philip Carey Manufacturing Co., 1935 Easton Boulevard, Lockland 15, Cincinnati, Ohio, produced 85-percent magnesia insulation and high-grade magnesium oxide from dolomite at its Plymouth Meeting (Pa.) plant.

Texas.—Arizona Chemical Co., 30 Rockefeller Plaza, New York 20, N. Y., recovered anhydrous magnesium sulfate from well brines at O'Donnell, Tex., for use in the rayon and textile industries. Dow Magnesium Corp., Midland, Mich., recovered magnesium chloride from sea water at the Defense Plant Corporation installation at Velasco, Tex., until closed in the latter part of the year. Dow Chemical Co. operated a smaller similar plant at Freeport, Tex. Shigley has described the Velasco operation.¹⁰ Gardner and Cates, new operators who began production of magnesite at Llano, Tex., in 1943, have now installed one rotary and one vertical kiln for calcining magnesite. Most of the output is shipped to Florida for use as a citrus fertilizer. C. E. Heinz, Llano, Tex., bought the Meramec mine at Llano from Meramec Minerals, Inc., Cleveland, Ohio, and began construction of a rotary kiln. The mine was temporarily closed in 1944. International Minerals & Chemical Co., Austin, Tex., recovered magnesium chloride from dolomite until November 1, when the plant was shut down. Processes are described by Manning and Kirkpatrick¹¹ and by Engineering and Mining Journal.¹²

Washington.—The Chewelah (Wash.) plant of Northwest Magnesite Co., 1800 Farmers Bank Building, Pittsburgh 22, Pa., continued a high rate of production of crude and floated magnesite for use in basic refractories. In anticipation of postwar demands, the firm opened its Keystone deposit.¹³

West Virginia.—Standard Lime & Stone Co., 2000 First National Bank Building, Baltimore 3, Md., continued to make "Sta-set" basic refractories by leaching most of the lime content from dolomite. This firm also produced precipitated magnesium carbonate for sale and for conversion to high-grade oxide.

FOREIGN COUNTRIES

Information on foreign developments in magnesite has been meager since the outbreak of the war. The latest Minerals Yearbook table showing world production by countries appeared in the volume review-

⁹ Avery, J. M., and Evans, R. F., Production of Magnesium at Painesville, Ohio: Am. Inst. Min. and Met. Eng. Tech. Pub. 1829, April 1945, 8 pp.; Modified MgO Process: Chem. and Met. Eng., vol. 52, No. 4, April 1945, pp. 94-96.

¹⁰ Shigley, C. M., The Plant of the Dow Magnesium Corporation at Velasco, Tex.: Am. Inst. Min. and Met. Eng. Tech. Pub. 1845, April 1945, 9 pp.

¹¹ Manning, P. D. V., and Kirkpatrick, S. D., Better Utilization of Mineral Resources through New Chemical Technology: Chem. and Met. Eng., vol. 51, No. 5, May 1944, pp. 92-96.

¹² Engineering and Mining Journal, Magnesium Metal from Carlsbad Potash: Vol. 145, No. 8, August 1944, pp. 70-75.

¹³ Rock Products, vol. 48, No. 1, January 1945, p. 230.

ing 1939. During the 5-year period 1934-38 the U. S. S. R. produced about 534,000 short tons of crude magnesite annually, followed by Austria with 403,000 tons, Manchuria 233,000 tons, United States 157,000 tons, Greece 134,000 tons, and Czechoslovakia 83,000 tons.

Brazil.—Recent investigations indicate magnesite in large deposits that occupy almost the entire Eguas Ridge northwest of the town of Brumado. Tonnage in sight has been calculated at over a hundred million. Analyses range from 20 to over 47 percent MgO .

Canada.—The value of Canadian production of magnesitic dolomite and brucite granules was \$1,260,056 in 1943, compared with \$1,059,374 in 1942. Deposits of magnesitic dolomite are worked at Kilmar and Harrington East, Argenteuil County, Quebec, for use in basic refractories. Brucite is recovered from limestone matrix at Rutherglen, Ontario, and at Bryson and Wakefield in the Province of Quebec.¹⁴

Union of South Africa.—Four companies produced 13,993 short tons of calcined magnesite in 1943, compared with 18,392 tons in 1942. Exports were 3,459 tons in 1943, compared with 6,620 tons in 1942.

Venezuela.—Magnesite on Margarita Island is being mined by a Venezuelan firm, La Industria Nueva Esparta C. A., which has a capital of \$90,000 and employs 200 workmen. The company has a plant in Caracas for making plastic magnesia products such as flooring, partitions, and ceilings. Production of crude magnesite was 589 metric tons in 1943. Analysis is 95 percent $MgCO_3$, 3 SiO_2 , 0.55 Al_2O_3 and Fe_2O_3 , and 0.75 percent CaO .

POSTWAR PROSPECTS

Available information indicates that there will be a considerable excess of supply of magnesia over demand in postwar years. Acute competition anticipated in certain grades may be made still keener if magnesium-metal producers and their affiliates should convert their plants to make magnesium oxide. Without undue difficulty, most of the plants that do not use the ferrosilicon process could convert to magnesia manufacture.

Little change is anticipated in present sources of maintenance-grade magnesia, but competition is expected to be active in brick-making grades of imported dead-burned magnesite and domestic sea-water magnesia, the former being a little cheaper (perhaps \$36 a short ton at Philadelphia as against \$40 or more for sea-water magnesia) but the latter offering greater purity and better control over final product.

The following table is indicative of possible supply and demand of magnesia in postwar years. The figures of possible production from converted magnesium plants do not include 30,000 tons of magnesium equivalent, which has been estimated as maximum postwar demand for this metal.

¹⁴ Canada Department of Trade and Commerce, Dominion Bureau of Statistics, Census of Industry, Mining, Metallurgical and Chemical Branch Report on The Miscellaneous Nonmetallic Minerals in Canada, 1943 (1945), p. 10.

Estimated postwar availability and requirements of magnesia in the United States, in short tons

Grade	Estimated postwar magnesium oxide available				Estimated postwar domestic requirements of magnesia
	From established magnesium oxide producers	Imports	From idle magnesium plants if converted	Total	
Refractory:					
Maintenance.....	278,000	{ 50,000 }	346,000	703,600	{ 100,000 }
Brick.....					
Caustic-calcined.....					
Pure grades.....	4,700			4,700	5,000
	309,300	53,000	346,000	708,300	185,000

DOLOMITE

Crushed dolomite, both raw and calcined, is used in large quantities added alone or mixed with slag in maintaining basic open-hearth furnaces. Total sales of dead-burned dolomite are given in the following table.

Dead-burned dolomite sold in and imported into the United States, 1940-44

Year	Sales		Imports ¹		Year	Sales		Imports ¹	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1940.....	867,900	\$6,925,328			1943.....	1,276,725	\$11,243,017	739	\$22,563
1941.....	1,069,887	9,111,172	64	\$654	1944.....	1,290,790	11,441,612	40	661
1942.....	1,229,357	10,817,634	449	11,260					

¹ Reported as "Dead-burned basic refractory material."

A new idea in stabilized dolomitic refractories was proposed by Seil,¹⁵ who found that when a dolomite-serpentine clinker was calcined at 3,500° F., the clinker remaining was stable in use at lower temperatures, preferably not higher than 3,200° F. The classical method of correcting low-melting monticellite (CaO-MgO-SiO₂) in a dolomitic refractory is to add lime to form high-melting dicalcium silicate. Schoenlaub¹⁶ suggests that, instead, the lime: silica ratio may be increased by adding the proper amount of fluorspar (theoretically one-third mole fluorspar for each mole monticellite) to the refractory mix. When heated in the kiln, the mix gives off silicon tetrafluoride. A little B₂O₃ is added to prevent inversion of the dicalcium silicate so formed.

Additional information on dolomite will be found in the chapter on Stone of this volume.

OTHER MAGNESIUM COMPOUNDS

Curtailment in production of magnesium metal forced a reduction in output of magnesium chloride in 1944. Production in 1945 is expected to be a great deal lower. Small declines were noted in

¹⁵ Seil, G. E., Conditioned Refractory Material: United States Patent 2,358,107 (1944).

¹⁶ Schoenlaub, R. A., assr. to Basic Refractories, Inc., Magnesia-Containing Refractories: United States Patent 2,364,002 (1944).

MAGNESIUM COMPOUNDS AND MISCELLANEOUS SALINES 1507

production of precipitated magnesium carbonate, most of which is used in making 85-percent magnesia insulation, and in output of magnesium sulfate, used as a fertilizer, in tanning, in pharmaceuticals, and in aqueous solution as a rayon coagulant. Sales of pharmaceutical-grade magnesium oxide and hydroxide were higher on account of the demand for high-grade oxide for use in synthetic-rubber catalyst.

Specified magnesium compounds produced, sold, and used by producers in the United States, 1943-44

Product	1943				1944			
	Produced (short tons)	Sold ¹		Used (short tons)	Produced (short tons)	Sold ¹		Used (short tons)
		Short tons	Value			Short tons	Value	
Precipitated magnesium carbonate.....	55,207	¹ 5,795	¹ \$509,405	¹ 49,462	52,918	4,845	\$448,619	47,917
Pharmaceutical grade magnesia and magnesium hydroxide.....	¹ 3,888	3,809	847,583	(¹)	¹ 4,694	4,391	923,695	(¹)
Magnesium chloride, 100 percent basis.....	640,708	55,740	1,931,036	587,089	525,223	19,086	712,826	508,365
Magnesium sulfate, 100 percent basis.....	26,710	26,415	1,320,104	-----	25,316	25,565	1,289,448	-----

¹ Sales by a producer to an affiliated consumer for immediate use are not included under "Sold" but under "Used."

² Partly estimated.

³ Exclusive of magnesia made from magnesium hydroxide, to avoid duplication.

⁴ Magnesia and magnesium hydroxide used by producing firms in making other magnesias are not shown.

Magnesium compounds imported for consumption in the United States, 1940-44

Year	Magnesium chloride (anhydrous and n. s. p. f.)		Magnesium sulfate (epsom salts)		Oxide or calcined magnesia		Magnesium carbonate, precipitated		Magnesium salts and compounds, n. s. p. f. ¹	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	(¹)	\$21	6	\$898	18	\$5,672	754	\$82,764	92	\$44,492
1941.....	28	1,328	1	179	12	4,292	1,106	113,236	23	11,488
1942.....	186	115,025	-----	-----	16	5,487	640	70,756	13	6,701
1943.....	-----	-----	-----	-----	(¹)	1	122	17,730	21	16,645
1944.....	-----	-----	22	1,812	30	9,485	151	26,703	22	12,799

¹ Magnesium silicofluoride or fluosilicate included under "Magnesium salts and compounds, n. s. p. f."

² 100 pounds.

³ 50 pounds.

Part II.—MISCELLANEOUS SALINES

CALCIUM CHLORIDE

Road stabilization, concrete mixing, and coal cleaning provided excellent markets for natural calcium chloride and calcium-magnesium chloride in 1944. There were 12 producers in 1944 and 11 in 1943. (The Bureau of Mines does not canvass firms that recover calcium chloride from ammonia-soda waste liquors; there were 2 such operators in 1944.)

The following firms reported production of calcium chloride (and calcium-magnesium chloride) from natural brines in 1944; California

Rock Salt Co., 2436 Hunter Street, Los Angeles 21, Calif., plant at Amboy, Calif.; J. Q. Dickinson & Co., Malden, W. Va.; Dow Chemical Co., Midland, Mich.; Hill Brothers Chemical Co., 2159 Bay Street, Los Angeles 21, Calif., plant at Amboy, Calif.; Liverpool Salt Co., Hartford, W. Va.; Michigan Chemical Corp., St. Louis, Mich.; Ohio River Salt Corp., Mason, W. Va.; Pomeroy Salt Corp., Pomeroy, Ohio, plant at Minersville, Ohio; Rademaker Chemical Corp., Eastlake, Mich.; Frank Thomas, Room 11, 374 Court Street, San Bernardino, Calif., plant near Amboy, Calif.; and Westvaco Chlorine Products Corp., 405 Lexington Avenue, New York, 17, N. Y., plants at Chula Vista, Calif., and South Charleston, W. Va.

Calcium chloride and calcium-magnesium chloride from natural brines sold by producers in the United States, 1940-44

[In terms of 75 percent (Ca, Mg) Cl₂]

Year	Short tons	Value	Year	Short tons	Value
1940.....	99, 536	\$998, 241	1943.....	199, 796	\$1, 549, 565
1941.....	165, 932	1, 333, 370	1944.....	200, 164	1, 621, 227
1942.....	224, 527	1, 733, 169			

Calcium chloride imported for consumption in and exported from the United States, 1940-44

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1940.....			8, 907	\$194, 738
1941.....	7	\$795	20, 777	511, 366
1942.....	1, 443	18, 926	8, 336	223, 184
1943.....	8, 000	102, 080	12, 725	434, 933
1944.....	2, 761	35, 125	8, 534	253, 641

The main use of calcium chloride is in road stabilization. A small percentage of calcium chloride is worked into a dirt binder, which is then used to fill voids between road aggregates. The calcium chloride, being hygroscopic, keeps the binder sufficiently damp to prevent lateral flow of the road surface under load. In this it is aided by internal friction of the road surfacing. Calcium chloride is added directly (2 pounds per sack of cement) to concrete mixes to obtain early strength, to prevent freezing, and to provide greater strength than ordinary concrete at all ages up to 1 year and perhaps beyond. Clay surfaces of temporary airfields have been stabilized successfully with calcium chloride. Postponed roadwork and construction are expected to provide a good market for this product in postwar years.

Prices of calcium chloride, according to Oil, Paint and Drug Reporter, were the same in 1944 and 1943, as follows: Flake, 77 to 88 percent, carlots, delivered, \$18.50 to \$35 according to zone; solid, 73 to 75 percent, \$18 to \$31.50 a ton, carlots, delivered; and 40-percent solutions, \$7.50 a ton, tank cars, works.

BROMINE

Sales of bromine compounds by primary producers again increased in 1944 to establish a new record. Sales of contained bromine amounted to 102,112,462 pounds, an increase of 9 percent over 1943. The increase was due largely to expanded production of ethylene dibromide for use in gasoline antiknock compounds.

Ethyl-Dow Chemical Co., pioneer producer of bromine from sea water, completed expansions at both its Wilmington, N. C., and Freeport, Tex., plants in 1944. Dow Chemical Co., Midland, Mich., second-largest producer, recovered bromine from Michigan well brines as a byproduct of magnesium and calcium chlorides. American Potash & Chemical Corp., Trona, Calif., recovered bromine from Searles Lake, and Westvaco Chlorine Products Corp., Newark and Chula Vista, Calif., from sea-water bitterns. The following won bromine from well brines: J. Q. Dickinson & Co., Malden, W. Va.; Great Lakes Chemical Corp., Filer City, Mich.; Michigan Chemical Corp., St. Louis, Mich.; Morton Salt Co., Manistee, Mich.; Pomeroy Salt Corp., Minersville, Ohio; Rademaker Chemical Corp., Eastlake, Mich.; and Westvaco Chlorine Products Corp., South Charleston, W. Va.

Bromine and bromine in compounds sold or used by producers in the United States, 1940-44

Year	Pounds	Value	Year	Pounds	Value
1940.....	59,266,275	\$11,772,515	1943.....	94,085,937	\$19,107,065
1941.....	68,317,019	11,506,213	1944.....	102,112,462	19,712,819
1942.....	65,880,935	13,729,383			

Bromine and bromides sold by primary producers in the United States, 1943-44

	1943			1944		
	Pounds	Value	Bromine content (pounds)	Pounds	Value	Bromine content (pounds)
Elemental bromine.....	4,171,537	\$860,461	4,171,537	3,742,307	\$766,059	3,742,307
Sodium bromide.....	4,553,376	947,567	3,551,634	1,452,901	273,839	1,133,263
Potassium bromide.....	2,953,044	643,009	1,978,539	2,687,604	586,948	1,800,695
Ammonium bromide.....	451,909	114,168	370,565	438,953	111,910	350,941
Other, including ethylene dibromide.....	99,074,044	16,541,860	84,013,662	112,281,833	17,974,063	95,076,256
	111,203,910	19,107,065	94,085,937	120,803,598	19,712,819	102,112,462

The largest use of bromine is in ethylene dibromide, which combines with the antiknock agent tetraethyl lead to form lead bromide. Lead in this form is not corrosive to spark points. Minor uses of bromine are in organic syntheses, in tear gas (bromobenzyl cyanide) as a chemical reagent, and in photographic emulsions. According to Oil, Paint and Drug Reporter, potassium and sodium bromides, U. S. P., granular, 500-pound barrels, works, were quoted at \$0.25 a pound in 1944. Bottled elemental bromine in cases, carlots, works, was quoted at \$0.21 a pound.

The bromine industry will undoubtedly be maintained at high levels in postwar years, as it is keyed directly to the sale of auto gasoline. Declines in the demand for fuels for military purposes should be offset by an increase in requirements for highway motor transport.

IODINE

There have been only two producers of iodine in the years 1937-44. In 1937, latest year for which figures may be shown, production was 299,286 pounds valued at \$242,422. Recent output, which is much higher than in 1937, is obtained from waste waters of oil wells near Los Angeles, Calif.; by Dow Chemical Co., Midland, Mich. (plant at Seal Beach, Calif.); and by Deepwater Chemical Co., Ltd., Victoria Avenue, Compton, Calif. Production decreased somewhat in 1944, compared with 1943, owing to large inventories in warehouses of the Chile Nitrate Sales Corp. (sales agent for producers of iodine from caliche in Chile).

Iodine is used as a disinfectant, in photographic emulsions, in organic syntheses, and in foodstuffs in iodine-deficient areas.

The price of crude iodine has been frozen by the Office of Price Administration at \$1.28½ per pound since 1942. Resublimed iodine in 5-pound bottles sold at \$2 to \$2.10 a pound during 1944.

The domestic iodine industry was well established before the war and has been a potent factor in reducing the price of Chilean iodine from \$4 in 1931 to as low as \$0.90 in 1936. In postwar years domestic iodine should retain at least the share of the market it had before the war.

Crude iodine imported for consumption in the United States, 1940-44

Year	Pounds	Value	Year	Pounds	Value
1940.....	1, 244, 146	\$1, 296, 181	1943.....	2, 744, 930	\$3, 041, 609
1941.....	1, 010, 039	1, 121, 513	1944.....	1, 204, 303	1, 321, 274
1942.....	951, 243	1, 051, 432			

SODIUM SULFATES AND CARBONATES

Sales of natural sodium sulfates were maintained at high levels in 1944 and sales of natural sodium carbonates established a new record, despite a general labor shortage.

The American Potash & Chemical Corp. increased its output of soda ash and desiccated sodium sulfate from its expanded facilities at Trona, Calif., using the brines of Searles Lake. The Arizona Chemical Co., 30 Rockefeller Plaza, New York City, continued its production of desiccated sodium sulfate from well brines at O'Donnell and Brownfield, Tex., for the sulfate pulp market. The Desert Chemical Co., 4031 Goodwin Avenue, Los Angeles 26, Calif., shipped desiccated sodium sulfate from stocks produced at its Dale Lake plant near Twentynine Palms, Calif. The Iowa Soda Products Co., Council Bluffs, Iowa (plant at Rawlins, Wyo.), continued its production of Glauber's salt for stock feed. The Natural Soda Products Co., 405 Montgomery Street, San Francisco, recovered sodium carbonate at Keeler, Calif., from the brines of Owens Lake, Inyo County.

The Ozark Chemical Co., Mid-Continent Building, Tulsa, Okla., recovered sodium sulfate at its Monahans (Tex.) plant, largely for sale to sulfate pulp mills. W. E. Pratt, Casper, Wyo., mined Glauber's salt near Casper for stock feed. Pacific Alkali Co., 1223 Pacific Mutual Building, Los Angeles 14, Calif., produced soda ash and trona from the brines of Owens Lake; the firm was purchased on December 1, 1944, by Pittsburgh Plate Glass Co., Columbia Chemical Division, 1223 Pacific Mutual Building, Los Angeles 14, Calif., which continued production. West End Chemical Co., 608 Latham Square Building, Oakland 12, Calif., increased its production of sodium carbonate from Searles Lake. Nearly all the producers were affected by a severe labor shortage, and maintenance of production at such high levels was a real achievement.

Sodium sulfate is used principally in the manufacture of kraft paper, glass, in stock feeds, and as a flux in metallurgy. Sodium carbonate is used on the Pacific Coast mostly in glassmaking and in alkali cleansers. The prognosis for active markets for natural sodium compounds after the war remains good, owing to cost and freight advantages. For example, light soda ash made by the ammonia-soda process at Corpus Christi, Tex., sells at \$18 a short ton, f. o. b. Corpus Christi, whereas soda ash can be laid down in Los Angeles by western producers at \$18 to \$19 a short ton.

Natural sodium sulfates and sodium carbonates sold or used by producers in the United States, 1940-44

Year	Sodium sulfates ¹		Sodium carbonates ¹	
	Short tons	Value	Short tons	Value
1940.....	184,571	\$1,528,633	130,034	\$1,629,283
1941.....	154,327	1,443,137	146,677	1,822,986
1942.....	169,870	1,669,983	150,619	2,145,289
1943.....	160,622	1,553,649	165,993	2,544,086
1944.....	168,923	1,577,982	184,826	2,869,243

¹ Tonnage figures for sulfates include Glauber's salt converted to 100 percent Na₂SO₄ basis. In earlier chapters of this series the figures given for sulfates include those for Glauber's salt not so converted and were as follows—1940: 187,233 tons; 1941: 157,524 tons; 1942: 175,033 tons; and 1943: 165,908 tons. Figures for 1940-42 include some burkeite.

² 1940-41: Soda ash, bicarbonate, and trona; 1942-44: Soda ash and trona.

Domestic salt cake was quoted at \$15 a short ton, bulk, works; anhydrous sodium sulfate at \$1.70 to \$1.90 per hundredweight, works; and Glauber's salt at \$1.05 to \$1.25 per hundredweight in 1944, according to Oil, Paint and Drug Reporter. Soda ash, calcined sodium carbonate, was sold at \$0.90 to \$3.25 a hundredweight, depending on grade and other factors. Prices were the same as in 1943.

Production data for sodium carbonate produced by the ammonia-soda process for the last 4 years, according to the Bureau of the Census, are: 1941, 3,606,826 short tons; 1942, 3,788,583; 1943, 4,407,618; and 1944, 4,538,398 tons. There are no official consumption figures for sodium carbonate, but the following table, published in Chemical and Metallurgical Engineering, may be indicative.

Estimated consumption of sodium carbonate in the United States, 1940-44, by industries, in short tons¹

Industry	1940	1941	1942	1943	1944
Glass.....	860,000	990,000	1,100,000	1,200,000	1,290,000
Soap.....	200,000	170,000	165,000	150,000	162,000
Caustic and bicarbonate.....	780,000	1,033,000	960,000	1,010,000	1,018,000
Other chemicals.....	730,000	800,000	840,000	950,000	1,030,000
Cleansers and modified sodas.....	65,000	70,000	80,000	85,000	90,000
Pulp and paper.....	123,000	155,000	145,000	155,000	160,000
Water softeners.....	55,000	70,000	80,000	95,000	110,000
Petroleum refining.....	20,000	23,000	18,000	20,000	22,000
Textiles.....	45,000	60,000	56,000	58,000	61,000
Nonferrous metallurgy.....	248,000	150,000	260,000	450,000	360,000
Miscellaneous.....		225,000	230,000	370,000	400,000
	3,126,000	3,746,000	3,934,000	4,543,000	4,703,000

¹ Chemical and Metallurgical Engineering—1940: Vol. 50, No. 2, February 1943, p. 105; 1941-43: Vol. 51, No. 2, February 1944, p. 113; 1944: Vol. 52, No. 2, February 1945, p. 129.

McCarthy and associates in the Bureau of Mines published papers on the extraction of potassium carbonate from wyomingite by digestion with sodium carbonate, which may be obtained from trona.¹⁷

Sodium metal.—There were two producers of sodium metal in 1944—E. I. duPont de Nemours & Co., Inc., Wilmington, Del., and Ethyl Gasoline Corporation, 405 Lexington Avenue, New York City. Production data may not be published. The former firm sells sodium for such uses as organic syntheses, alloys, and metallurgical scavenger; the latter producer consumes its output in making tetraethyl lead, the gasoline antiknock. Metallic sodium has been under allocation (M-300-16) since November 15, 1943, to assure adequate supplies for the manufacture of tetraethyl lead. Ragno reviewed industrial uses of sodium.¹⁸

The price of sodium metal in 1944 was 15 cents a pound in blocks, carlots, works.

BORATES

Expanded exports and increased use in the manufacture of glass and fertilizer accounted for the highest boron-mineral production since 1941. Sales of contained B_2O_3 were 91,700 short tons in compounds valued at \$6,579,587, a quantity increase of 5 percent over 1943.

American Potash & Chemical Corp., 122 East Forty-second Street, New York City, continued its extraction of borax, dehydrated borax, and boric acid from the brines of Searles Lake at Trona, Calif. Pacific Alkali Co., 1223 Pacific Mutual Building, Los Angeles, Calif., recovered borax from Owens Lake at Bartlett, Calif.; this firm was purchased by Columbia Chemical Division, Pittsburgh Plate Glass Co., 1223 Pacific Mutual Building, Los Angeles, on December 1, 1944, at which time a labor shortage prevented further production of borax in 1944.

¹⁷ McCarthy, C. E., and Green, S. J., Extraction of Potassium Carbonate from Wyomingite: Ind. and Eng. Chem., ind. edit., vol. 36, No. 5, May 1944, pp. 412-414.

McCarthy, C. E., and Ervin, Guy, Jr., Separation of Sulfate and Chloride from Alkali Carbonate Brines: Ind. and Eng. Chem., ind. edit., vol. 36, No. 5, May 1944, pp. 415-420.

McCarthy, C. E., and Meyer, E. G., Removal of Dissolved Silica from Alkali Carbonate Brines: Ind. and Eng. Chem., ind. edit., vol. 36, No. 5, May 1944, pp. 420-422.

¹⁸ Ragno, M., Chim. ind. agr. biol., vol. 18, pp. 358-361 (1942); Chem. Zentr., vol. 1943, I, p. 1920; Chem. Abs., vol. 38, No. 16, Aug. 20, 1944, p. 4389.

Pacific Coast Borax Co. increased its production of kernite and tincal from its mines at Boron, Calif., for use in over 200 boron derivatives; the firm is expanding its plant in anticipation of heavy post-war demand. United States Borax Co., 510 West Sixth Street, Los Angeles, mined colemanite (crude calcium borate) near Shoshone, Inyo County, Calif., for refining by another producer.

West End Chemical Co., 608 Latham Square Building, Oakland, Calif., recovered borax and dehydrated borax from Searles Lake at its Westend plant.

American Potash & Chemical Corp. and Pacific Coast Borax Co. were indicted September 14, 1944, for an alleged conspiracy to restrain interstate commerce in boron compounds. The United States Department of Justice filed a civil complaint against the same defendants on the same date in the United States District Court for the Northern District of California, Southern Division.

The price of technical borax, granular, bulk, freight allowed, remained at \$41.50 a short ton throughout 1944, as in 1943 and 1942, according to Oil, Paint and Drug Reporter.

The main use of boron compounds at present is in glass. Other uses are in water treatment, soaps, medicines, ferrous alloys, flame-resisting paints, and fertilizers. Before the war, the main use was in enamels, but this market has been negligible as the result of the shortage of steel for making enamelware. Interest in boron fertilizers is increasing. Kernite concentrates, borax, and boric acid are used on boron-deficient soils to prevent corky pit in apples, heart rot and crown rot in sugar beets, brown heart in turnips and swedes, and cracked stems in celery, and to promote the growth of citrus trees, alfalfa, and cotton. The Pacific Coast Borax Co. recently revised its publication "Boron in Agriculture," which indicates the advantages of boron-fertilization.

The United States continues to be the world's main source of boron minerals, and producers have every expectation that reconversion in the United States and abroad will afford a demand at least equal to that of prewar years.

Salient statistics of the boron-mineral industry in the United States, 1940-44

	1940	1941	1942	1943	1944
Sold or used by producers: ¹					
Short tons:					
Gross weight.....	243,355	301,282	226,723	256,633	277,596
B ₂ O ₃ content.....	80,900	95,200	77,600	87,600	91,700
Value.....	\$5,643,390	\$6,785,662	\$5,733,648	\$6,401,507	\$6,579,587
Imports for consumption (refined): ²					
Pounds.....	752	2,025			
Value.....	\$185	\$92			
Exports:					
Short tons.....	64,313	41,793	36,542	26,877	32,759
Value.....	\$2,456,523	\$1,893,500	\$1,562,794	\$1,282,372	\$1,601,014
Apparent consumption: ³					
Short tons.....	179,042	259,490	190,181	229,756	244,827

¹ 1940-41: Borax, kernite, boric acid, and colemanite; 1942-44: Borax, anhydrous sodium tetraborate, kernite, boric acid, and colemanite.

² Also 525 pounds of crude valued at \$7 in 1943.

³ Quantity sold or used by producers plus imports minus exports.

GEM STONES

By SYDNEY H. BALL

SUMMARY OUTLINE*

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JEWELRY INDUSTRY IN 1944

The sales value of taxable jewelry in 1944 reached a record total of approximately \$1,063,000,000, 7 percent above the previous high of \$998,094,416 set in 1943. The gain is attributed principally to increases in prices rather than to a larger volume. Sales were unusually heavy during the first quarter, but from April to August they fell below the corresponding months in 1943, owing to an increase in the excise tax to 20 percent on April 1 and the belief, then current, that the war would end soon. The public had become accustomed to the new tax by September, and for the last 4 months of the year sales exceeded those of the corresponding months of 1943. Christmas shopping, which began as early as September because so many were overseas, also exceeded that of 1943. Diamonds, Swiss watches, rings, and gold-plated silver-based jewelry were the leading items. Medium-price articles sold best, although some very expensive items were purchased, probably as a hedge against inflation.

Taxes on jewelry in 1944 were \$152,765,380, an increase of 53.6 percent over those of 1943, due largely to the higher tax rate.

Prices rose somewhat in 1944 but on the whole probably less than those of good clothes or other comparable commodities.

The prosperity of the jewelry trade was based upon a record national income (161 billion dollars, compared with 147.9 billion in 1943), a large number of weddings, much cash in the hands of the average citizen, and subnormal competition for the American spending dollar.

Sales by wholesalers were somewhat less than those of 1943, and, owing to a shortage of labor and restrictions on the use of certain metals, their stocks decreased in 1944. The resale of old jewelry bolstered retailers' volume.

The retailers increasingly feel the competition by the department stores, and the sales of the latter show greater increases than those

of the retailer. A number of department stores conduct a brokerage business in used jewelry, said to be profitable. Upstairs distributors and door-to-door solicitors also compete with the sale of medium-price items, the bread and butter of the retailer.

The Canadian retailer had a good year, as did his South African and Australian confreres, although each was plagued by a shortage of stocks. By the purchase and resale of old jewelry, a vestige of life is kept in the British trade.

Costume jewelry is now a big business, sales running into several tens of million dollars a year. Base metals, silver, glass, ceramics, plastics, and a host of other materials are used, and prices of individual items have skyrocketed.

POSTWAR PROSPECTS

As to the postwar outlook, competition within the retail trade will be keen, but for a time the jewelry trade will have an advantage, for its reconversion should be rapid. One encouraging factor is that during the war many Americans have repressed a desire to spend money on beautiful things. However, if in the postwar period a substantial reduction in the national income occurs, the jewelry trade will be more adversely affected than trades dispensing food, clothes, and other necessities. With the re-entry of the European cutters into the market, gem cutters in the United States, South Africa, and Palestine will have keener competition. Some of the war-born cutting centers are likely to shrink in size or disappear. Although the consumption of industrial diamonds may decrease for a time, their expanding use in drill bits and wire-drawing dies indicates that the industrial market will be well-maintained.

FASHIONS IN JEWELS

Diamonds always show to best advantage when set in white metal. Until the war is over, palladium serves as a reasonable substitute for platinum, but thereafter platinum, without much doubt, will be the mounting par excellence for fine gems. Gold, often in two or three tones, was used, particularly in mounting colored stones; silver for the less precious stones. Even ultrafashionable jewelers began mounting garnets and other less costly but effective gems with diamonds, rubies, and sapphires. Flower designs (sometimes mounted on springs), ribbons often tied in bowknots, butterflies, and tiny animals were popular, and Victorian jewelry sprang into popularity. Egyptian motifs in necklaces are effective. Multiple-use jewelry and single-gem ensembles, clips and pins worn on coats, gowns, and hats, bracelets, earrings, and rings remained popular, whereas choker collars and hair ornaments were innovations. Stones of tremendous size are worn in rings, bracelets, and pendants. The double-ring ceremony now predominates at weddings, the service husband desiring a tangible link with his far-off wife; even double engagement rings are now used, the groom-to-be wearing a seal or crest ring.

Melee (small diamonds) to mount fine gems continued to be in short supply and expensive and were replaced in part by cabochon rubies and sapphires. Diamond, ruby, and sapphire (multicolored sapphires continued their vogue) led in popularity, followed by

topaz (true and citrine), aquamarine, emerald, and amethyst. Many other stones were worn, and the peridot is deservedly gaining popularity.

The ever-insistent demand for diamonds caused colorless, then blue and red, stones to be dominant, followed by yellow, green, and purple stones.

DOMESTIC PRODUCTION

In 1944, the value of uncut stones from domestic sources used in jewelry and related industries approximated \$41,000, which is substantially lower than the \$67,000 and \$150,000 reported in 1943 and 1942, respectively. The professional gem miner sought strategic minerals; the amateur collector did not have gasoline or tires to pursue his hobby, and the tourist (the principal purchaser of domestic gem stones) was almost nonexistent. The western lapidaries, professional and amateur, largely cut stock collected in a happier day. A few gem stones were byproducts of the intensive search for mica in the New England States.

As producers, the leading States ranked as follows: Arizona, Wyoming, Colorado, Washington, Montana, and Oregon.

Turquoise was the leading gem produced, its value having been about \$17,000. Miami, Ariz., is a new locality. The Castle Dome Copper Co., Inc., states that in its open pit "occasional specimens of turquoise are uncovered during routine mining operations. Occurrence is in the form of small veinlets. Although of sufficient hardness for gem purposes, most of this material is of a very pale-green or blue color, requiring impregnation with oil to darken the stones before they are of commercial value." Presumably, the better stones are collected and perhaps sold by the miners.

W. P. King and two miners worked the King mine, 11 miles southeast of Manassa, Colo., for about 3 months in 1944. He estimates the value of the finished product at \$7,000. The Hall and Ashcroft turquoise properties in Colorado were not operated. Apparently, the mine near Beowawe, Nev., did not operate in 1944, nor did Los Cerrillos in New Mexico. The Navajo and Pueblo silversmiths look to Colorado, Arizona, and other States for the turquoise used in their jewelry.

Agates, jaspers, and related quartz minerals probably were next in importance. Most of them are obtained in Washington and Oregon. Other producers were Montana (moss agates), Arizona (agatized wood and chalcedony), Idaho, Colorado (agates), South Dakota (agates), and Wyoming (Sweetwater moss agates). Scotts Rose Quartz Co., Custer, S. Dak., sold a little rose quartz for jewelry use and larger quantities of lower-grade material for rock gardens.

Bert A. Rhoades reports that 3,000 to 4,000 pounds of jade (nephrite) were mined in the Lander, Wyo., field. He and Byford Foster ran small cutting shops continuously and readily sold all they could cut. Three other cutters worked part time. Fred Abernathy sank a pit on nephrite in place, but the nephrite so far found is partly altered. In the summer of 1944 rough nephrite was being sold at \$1 to \$10 a pound. Some of the green jade is of good quality, and the black makes a good material for objets d'art.

Chinese agents purchased 5,890 pounds of Wyoming jade during the year to be shipped to China after the war.

The Montana sapphire industry had a poor year. Virtually all this sapphire is used industrially, only a small percentage being set in jewelry. The Perry-Schroeder Mining Co. of Helena, Mont., operated during only the first 4½ months of 1944. It produced about 4,500 ounces of culled sapphire containing \$200 to \$300 worth of gem material. No other Montana sapphire mine operated.

Alfred M. Buranek reports that the Clay Canyon, Utah, variscite deposit was worked for a short time in 1944, and that some good nodular variscite was shipped to the East. Smaller amounts were recovered from the Grantsville (Tooele County) and Lucin (Box Elder County) deposits. He estimates the value of the 1944 Utah production at approximately \$2,000. He adds that Japanese internees collected some topaz from Topaz Mountain; that a little fine malachite and azurite were obtained from the Dixie Apex mine near St. George; and that other gem stones collected in the State included "snowflake obsidian" (Black Creek), jet (southeastern Utah), and agate and chalcedony. Chalcedony was also found near Fruita, Mesa County, Colo.

Dr. Stuart A. Northrop reports that some fine green smithsonite was produced in the Magdalena district, Socorro County, N. Mex.

Other gem stones produced in the United States in 1944 were transparent albite (Newry, Maine), amethyst (Stow, Maine), aquamarine (Newry, Maine; New Hampshire; North Carolina; and Virginia), caesium beryl (Maine), garnet (Arizona), golden beryl (Maine), obsidian (Arizona), peridot (Arizona), white topaz (Maine), and colored tourmaline (Rumford, Maine).

In 1944, John Adair published a scholarly ethnologic study of American Indian silversmiths, entitled "The Navajo and Pueblo Silversmiths."

CANADIAN GEM STONES

Apparently there was no gem-stone production in Canada in 1944.

A. W. Jolliffe, of the Canadian Geological Survey, writes that in the Yellowknife Beaulieu pegmatites, Northwest Territories, small crystals of blue-green tourmaline are common; larger ones occur, but they are usually of poorer quality; red tourmaline is less common; and deep blue lazulite, possibly of gem grade, also occurs. He reports that sapphire is found in quartz at Outpost Islands, Great Slave Lake; cordierite, in the same region; fine chiastolite at Quyta Lake, 20 miles north of Yellowknife, and translucent brownish to mauve-pink andalusite in quartz bodies cutting aluminous sediments.

ACCESSIONS TO MUSEUMS

Dr. E. P. Henderson, of the United States National Museum, reports that a cat's-eye emerald of 4.56 carats was added to the Roebling collection in 1944. The chatoyant band is well-developed, and the color of the emerald is a good green. He adds that a new mineral, brazilianite, from Brazil, a hydrous sodium-aluminum phosphate, has gem possibilities; and Dr. Frederick H. Pough, of the American Museum of Natural History (New York), reports that he has two gems, each of about 20 carats, cut from brazilianite. They are slightly green-yellow in color and very brilliant.

A number of rock-crystal seals belonging to former Emperors of China have recently been placed on exhibition in the Philadelphia Museum of Art. They and many other examples of Chinese art were given to the museum by Major General and Mrs. William Crozier of Washington.

IMPORTS ¹

The value of imports of precious and semiprecious (real and imitation) stones, exclusive of industrial diamonds, totaled \$77,529,806, 8 percent more than in 1943. The value of imports of rough diamonds, emeralds, pearls, and "other precious and semiprecious stones" increased, whereas that of cut but unset diamonds decreased.

Precious and semiprecious stones (exclusive of industrial diamonds) imported for consumption in the United States, 1943-44

Commodity	1943		1944	
	Carats	Value	Carats	Value
Diamonds:				
Rough or uncut (suitable for cutting into gem stones), duty free.....	751,240	\$37,443,240	896,547	\$43,445,219
Cut but unset, suitable for jewelry, dutiable.....	193,701	31,458,089	160,007	29,263,121
Emeralds:				
Rough or uncut, free.....	8	248	1,966	1,668
Cut but not set, dutiable.....	3,194	32,508	38,666	81,233
Pearls and parts, not strung or set, dutiable:				
Natural.....		167,284		242,221
Cultured or cultivated.....		107		15,394
Other precious and semiprecious stones:				
Rough or uncut, free.....		47,726		105,401
Cut but not set, dutiable.....		2,590,931		3,725,453
Imitation, except opaque, dutiable:				
Not cut or faceted.....		2,621		14,550
Cut or faceted:				
Synthetic.....		167,166		503,718
Other.....		102,450		23,887
Imitation, opaque, including imitation pearls, dutiable.....		8,149		23,113
Marcasites, dutiable: Real.....		96,154		84,828
		72,116,673		77,529,806

GOVERNMENT REGULATIONS

In January 1944, the use of gold and palladium in the manufacture of jewelry was liberalized, and on August 14, 1944, all restrictions were removed by the War Production Board, the two metals no longer being in short supply. The restrictions against copper interliners in gold-plated and gold-filled stock were almost simultaneously modified. Iridium was released from allocation on July 21, 1944, although the conservation provisions of the allocation order remained in force. The supply of this metal has been increased. No release of restrictions on the use of platinum can be expected for some time, as military and essential requirements for the metal remain large.

The War Production Board virtually prohibited the sale after March 1, 1945, of any jewelry containing tin.

Although brass may be used for silver-plated flatware, no nickel is available for production of nickel-silver. As the silver trade must depend entirely on newly mined silver, the production of silverware in the United States is small today.

¹ Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Government regulations for control of the jewelry industry are not confined to the United States. As of October 15, 1944, the Japanese Munitions Ministry required that all platinum in the hands of its citizens be sold to the Government, indicating the severe shortage of that important war metal in Japan.

Late in October, Sweden further restricted the importation of gold, platinum, and other valuables, presumably to prevent the Nazis from using Sweden as a haven for their ill-gained wealth.

On August 1, 1944, Canada permitted the importation of jewelry from the United States. However, taxes of one sort or another are so high that it is unlikely that the trade can be large. On September 11, 1944, Canada permitted free production of jewelry and silverware, except that of items in which tin or platinum is used. Price control continues.

EFFECT OF WAR UPON THE GEM-STONE TRADE

Aerial bombing and artillery fire have doubtless destroyed some of the fine, historical, ecclesiastical jewelry of Europe; for example, that of St. Gennaro, patron of Naples, said to have been sent for safekeeping to the Monte Cassino monastery.

In October, the State Department announced that that department and Great Britain had asked neutral countries to deny protection for the Nazi loot, including jewelry. Some of the latter is in safe-deposit boxes in neutral countries under non-German names.

The war industries have borrowed from the jewelry trade methods of precision casting, both the "lost wax" and plaster-of-paris methods.

Although colored stones, especially ruby and sapphire, and many of the lesser gem stones have never been more popular, most of the world's colored-stone mines (except those of Brazil) are shut down. Consequently, many of the colored stones used today in jewelry are coming from stocks or from old jewelry. The restricted supply accounts for the rise in prices.

With the fall of the Vichy Government, the diamond production of French Guiana, perhaps totaling 20,000 carats a year, fell into the hands of the United Nations.

As the year ended, the Mogok ruby mines, heavily bombed in December, were still in the hands of the Japanese, but the Burmese jade and amber mines had been regained by the United Nations. The Mogok ruby mines apparently were won early in March 1945.

Of course, the gem mines of Thailand and Indochina were still in enemy hands. The shortage of fine cultured pearls, Japan-grown, is reflected in higher prices.

The Chinese, having been until recently cut off from one of their principal sources of jade (Burma), are investing in fine jade, the stock of which is depleted.

Our boys in the Armed Forces in India and Ceylon have purchased cultured pearls, synthetic gem stones, and glass imitations as real gems. The swindle is usually first detected when the "gems" are appraised by the American customs authorities or by some organization like the Gemological Institute of America. Similar tricks are age-old in the Orient, and even the expert is on his guard when buying gems in the East.

On the other hand, some of our men overseas make worthwhile purchases, and the star sapphires, emeralds, and cameos they acquire may well be valuable heirlooms generations hence.

DIAMOND

Although 1944, the sixth year of World War II, was not quite as good a year in the diamond industry as 1943, under the circumstances, it was much better than might have been expected. The demand for both industrial and gem stones was excellent.

Production expanded owing largely to greater production of bort from the BCK mines and of gem stones from South Africa. West African output (Gold Coast and Sierra Leone) also may have been larger. Stocks continued to decrease, consumption again exceeding production, particularly of industrial grades.

Diamond cutting appeared stabilized at about 11,000 artisans, enough to satisfy the world demand for "virgin" cut, supplemented, as it was, by well-cut stones from old jewelry.

The price of gem stones (both rough and cut) increased, but in the early fall, when some foresaw the immediate reopening of the Belgian cutting shops, the price of small cut slumped badly. By the end of the year, however, the loss had been overcome. The price of industrial stones remained stable.

Share dealings.—The shares of diamond-mining companies, virtually all of which are listed on the London Stock Exchange, registered a slight loss during the year, their performance being less satisfactory than that of the average stock on either the London or the New York exchange.

Market.—Sales in 1944 by the Diamond Trading Co., which in pre-war times sold about 95 percent of the world's production, were somewhat over £17,000,000 worth of rough, compared with £20,400,000 in 1943, the record year. Sales of gem stones held up better than did those of industrials. At several of the "sights," more stones could have been sold if there had been enough sorters to prepare them.

The American retail trade prospered in 1944, and diamond sales probably reached a peak, topping those of 1943 slightly. Sales of diamonds at retail have probably doubled since World War II began.

The price of fine cuttable rough continued to advance in 1944. Since 1939, small cut has tripled or quadrupled in price; fine cut stones have doubled in price, the increase in the case of larger stones being somewhat less.

Stocks of diamonds, both in the producers' and the Diamond Corporation's hands, have continued to decrease, and for some fine grades of industrials we are now dependent entirely on production.

Imports.—The total value of imports of gem diamonds in 1944 exceeded that of 1943, a gain of 16 percent in rough or uncut imports offsetting the loss of 7 percent in cut but unset diamonds. The quality of rough imports decreased somewhat, but that of cut, considering the slight increase in price in 1944, was constant in the two years.

Diamonds imported into the United States, 1943-44, by countries

[Exclusive of industrial diamonds]

Country	Rough or uncut			Cut but unset		
	Carats	Value		Carats	Value	
		Total	Average		Total	Average
1943						
Argentina.....				67	\$12,590	\$187.91
Belgian Congo.....	1,840	\$42,294	\$22.99			
Belgium and Luxemburg.....	1,369	21,444	15.66	19,693	1,341,493	68.12
Brazil.....	5,773	557,541	96.58	40,933	6,487,150	158.48
British Guiana.....	2,254	46,243	20.52	185	21,839	118.05
Canada.....				49	5,255	107.24
Cuba.....				21,913	3,340,950	152.46
France.....				567	99,401	175.31
French Guiana.....				19	2,010	105.79
Gambia and Sierra Leone.....	3,861	80,432	20.83			
Gold Coast.....	1,000	17,653	17.65			
Mexico.....				406	41,273	101.66
Netherlands.....				569	121,524	213.57
Palestine and Trans-Jordan.....				50,361	9,153,273	181.75
Peru.....				14	1,283	91.64
Portugal.....	11	225	20.45	83	10,888	131.18
Portuguese Guinea and Angola.....	7,664	40,141	24.12			
Switzerland.....				112	22,773	203.33
Union of South Africa.....	705,429	35,502,163	50.33	33,394	6,667,871	199.67
United Kingdom of Great Britain and Northern Ireland.....	20,262	782,350	38.61	25,336	4,128,516	162.95
Venezuela.....	7,777	352,754	45.36			
	751,240	37,443,240	49.84	193,701	31,458,089	162.41
1944						
Australia.....				1	500	500.00
Belgium and Luxemburg.....	(1)	5	5.00	641	137,063	213.83
Brazil.....	25,619	726,378	28.35	25,031	4,219,310	168.56
British Guiana.....	2,613	64,405	24.65	532	61,162	114.97
Cuba.....				43,683	6,749,686	154.52
Gambia and Sierra Leone.....	725	13,164	18.16			
Gold Coast.....	1,350	24,860	18.41			
Mexico.....				1,092	30,738	28.15
Netherlands.....				20	11,423	571.15
Palestine and Trans-Jordan.....				53,883	9,337,281	173.29
Union of South Africa.....	854,239	42,197,278	49.40	32,676	6,514,128	199.36
U. S. S. R.....				1,436	202,180	140.79
United Kingdom of Great Britain and Northern Ireland.....	6,201	233,977	37.73	10,102	1,999,650	197.95
Venezuela.....	5,800	185,152	31.92			
	896,547	43,445,219	48.46	169,097	29,263,121	173.06

1 Less than 1 carat.

Cutting.—Before 1940, about 90 percent of the world's diamonds were polished in the Low Countries—Belgium and the Netherlands. Since then the industry has been widely scattered over the world. The 11,000 artisans and apprentices (about one-third the prewar force) adequately supplied the world with cut stones, notwithstanding the fact that for perhaps 20 percent of their time they were unemployed (strikes, lockouts, and shortage of rough). The United States, Palestine, and Brazil are the current cutting centers.

World production.—Owing to the war, accurate figures as to diamond production are not available. The figures given for 1944 production in the table that follows are entirely estimates, but the grand total is probably approximately correct.

The world production of diamonds in 1944 is believed to have been valued at about \$40,000,000. The increase in caratage is due to an increase in BCK's crushing bort production of some 2,650,000 carats; to expansion of output in Sierra Leone, the Gold Coast, and the

South-West African alluvial mines; and to an appreciably larger production in the South African pipe mines. The value as well as the production was larger, because of increased pipe production. Of the total, some 80 percent was industrials and 20 percent gem stones.

Figures showing the production for 1940-44, corrected in minor details from those published in the chapter of this series for 1943, follow.

World production of diamonds, 1940-44, by countries, in metric carats
[Including industrial diamonds]

Country	1940	1941	1942	1943	1944 (estimated)
Africa:					
Angola.....	784, 270	787, 000	1 791, 850	794, 990	800, 000
Belgian Congo.....	9, 603, 000	5, 866, 000	6, 018, 236	4, 880, 000	7, 540, 000
French Equatorial Africa.....	1 16, 000	30, 000	20, 000	20, 000	5, 000
French West Africa.....	1 75, 000	35, 000	20, 000	20, 000	20, 000
Gold Coast.....	1 825, 000	1, 000, 000	1 1, 000, 000	1, 000, 000	1, 000, 000
Sierra Leone.....	750, 000	850, 000	1 850, 000	850, 000	850, 000
South-West Africa.....	30, 017	46, 578	56, 420	100, 000	154, 000
Tanganyika *.....	6, 222	29, 052	40, 327	52, 998	53, 000
Union of South Africa:					
Mines.....	1 371, 447	.....	.....	170, 885	550, 000
Alluvial.....	1 172, 027	158, 422	117, 628	1 131, 444	148, 525
	543, 474	158, 422	117, 628	302, 329	698, 525
Brazil.....	1 325, 000	325, 000	300, 000	275, 000	(1)
British Guiana.....	1 26, 764	27, 000	27, 000	27, 000	27, 000
Other countries *.....	31, 750	34, 350	40, 836	29, 650	34, 000
	13, 016, 497	9, 188, 402	9, 282, 297	8, 351, 967	* 11, 500, 000

1 Estimate.

2 1940 and 1944: Exports; 1941-43: Production.

3 Cape and Transvaal, without Namaqualand, estimated at 53,210 carats.

4 250,000 to 370,000 carats.

5 1940-41: Borneo, India, New South Wales, U. S. S. R., and Venezuela (Venezuela produced, respectively, 14,525 and 29,399 carats); 1942: Borneo, India, New South Wales, Rhodesia, U. S. S. R., and Venezuela (Venezuela produced 31,570 carats); 1943: Venezuela (23,020 carats), Borneo, India, New South Wales, U. S. S. R., United States (Arkansas), and Bolivia; 1944: Venezuela (22,037.07 carats), Borneo, India, New South Wales, and U. S. S. R.

* Approximate.

Industrial diamonds.—World War II has been fought not only by cannon and other heavy munitions but by industrial diamonds, quartz plates, calcite prisms, and cathode-ray tubes. The diamond in over-alls is used in making virtually every kind of war munition, owing to the closer tolerances gained and time saved by its use.

Industrial diamonds are normally a byproduct of gem mining. However, in the carbonado mines of Bahia, Brazil, and the large BCK mines in the Belgian Congo, the gem stone is the byproduct.

Although the United Nations have at their disposal the production from about 99.9 percent of the world's diamond mines, yet, notwithstanding the increased production of industrials in 1944, at least a quarter of the stones used by them must be drawn from stocks mined before the war.

The supply situation of the United Nations is believed to be comfortable. Japan, on the other hand, is desperately attempting to confiscate gem stones for industrial use, and the Germans were using sintered-carbide-tipped tools as a substitute.

The demand for crushing bort continues at a record level. Dr. H. Whittaker emphasizes that the cheaper grades of industrials can replace the more expensive grades for most purposes at a saving in

cost. The consumer is learning to use the cheaper grades, as many of the finer grades are in short supply.

Owing to the exploration boom in the gold fields, more drilling was probably done in Canada in 1944 than ever before. The use of the diamond drill in blast-hole drilling is also expanding.

Fine, sound diamonds, some of gem grade, are used in making diamond dies. Since the war began, the United States has become self-sufficient in the production of dies, even those with small apertures.

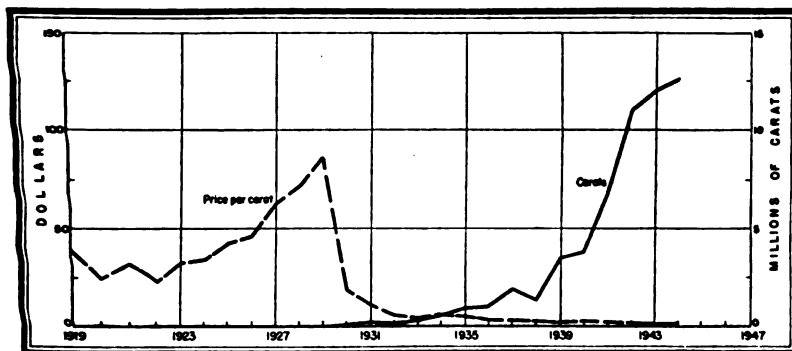


FIGURE 1.—United States imports and average price per carat of industrial diamonds, 1919-44.

Figure 1, prepared by Herbert Backman, illustrates the tremendous increase in use and the sharp decline in average price per carat of industrial diamonds during recent years.

Imports of industrial diamonds into the United States during the past 5 years were as follows:

Industrial diamonds (glaziers', engravers', and miners') imported for consumption in the United States, 1940-44

Year	Carats	Value		Year	Carats	Value	
		Total	Average			Total	Average
1940.....	3, 809, 071	\$11, 026, 563	\$2. 89	1943.....	12, 084, 133	\$21, 890, 568	\$1. 81
1941.....	6, 882, 248	14, 908, 809	2. 17	1944.....	12, 614, 507	22, 816, 827	1. 81
1942.....	11, 203, 704	22, 057, 577	1. 97				

RUBY, SAPPHIRE, AND EMERALD

The emerald mines of Colombia were not operated. The Burmese, Siamese, and Indochinese gem mines (largely sapphire and ruby) may have been operated on a small scale; they were in enemy hands. The Ceylonese mines were bled of labor by the island graphite mines. The production of gems, therefore, was small in 1944.

An unusually large star sapphire was exhibited for sale in New York early in 1945. It is said to have weighed over 800 carats in the rough; it was cut into a stone of 392½ carats.

LESSER GEMS

Dr. Frederick H. Pough, in a series of articles that appeared in the *Jewelers' Circular-Keystone* in 1944, has made an important contribution to our knowledge of the Brazilian gem stones. The articles contain valuable data on gem-stone prices received by miners in the field as well as dealers' prices at Rio; geographical and geological occurrence of the various gems; the heat-treatment of some of the gems; and the Brazilian cutting industry. At present Brazil is the largest producer of the lesser gem stones.

Up to the end of 1939, Australia had produced opals valued at £1,987,090. Incomplete returns for 1939 follow: New South Wales, £1,020; Queensland, £50 (only seven miners); South Australia (Coober Pedy field), £6,020—a total of £7,090. In 1944, it was reported that the black-opal fields were no longer operated.

The Anglo-American Corporation of South Africa and the South-West Africa Co. in 1943 formed the Kaokoveld Exploration Co. to prospect for minerals and precious stones in the Kaokoveld territory. This area, of 40,000 square miles, is in the northwestern part of South-West Africa.

Rubellite (red tourmaline) of excellent quality is reported to occur in Mozambique (Portuguese East Africa).

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NITROGEN COMPOUNDS¹

By BERTRAND L. JOHNSON

SUMMARY OUTLINE

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GENERAL CONDITIONS

Domestic consumption of nitrogen reached a new peak in 1944. In the first half of the year, as in 1943, allocations for agricultural use were increasing because of declining ordnance demands and expanding production. However, the downward trend in munitions production was revised abruptly in midyear with recognition of the need for more explosives in the coming military campaigns. As a result nitrogen deliveries to the fertilizer industry were slashed as early as August 1944, notwithstanding the fact that nitrogen was still urgently needed to meet the greatly increased food-production programs.

From midsummer on, increasing military demands reduced nitrogen supplies for 1944-45 crops, and at the end of the year it was believed that the quantity of nitrogen available to agriculture would be less than was used in the previous year. In June 1944 it had been anticipated that at least 675,000 tons of nitrogen would be obtainable for fertilizers, or about 7 percent more than the 630,000 tons used in 1943-44. In September estimates placed the possible supply at only 530,000 tons, but in November expectations had risen slightly to 576,000 tons.

The annual nitrogen capacity of the United States is about 1,450,000 tons,² of which 750,000 tons is that of Government plants and 700,000 tons that of plants belonging to private owners.

Salient statistics of nitrogen compounds in the United States, 1943-44, in short tons

	1943	1944
Production:		
Ammonia (NH ₃):		
Synthetic plants: Anhydrous ammonia ^{1 2}	543, 804	544, 156
Byproduct coking plants:		
Aqua ammonia (NH ₃ content).....	34, 106	31, 665
NH ₃ content of ammonia sulfate.....	190, 317	204, 561
NH ₃ equivalent all forms.....	224, 423	236, 226
Ammonium sulfate:		
Synthetic plants ¹	65, 000	88, 000
Byproduct coking plants.....	761, 270	818, 244
Sodium nitrate; ³ Total synthetic and byproduct plants.....	500, 000	(4)

See footnotes at end of table.

¹ Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

² U. S. Department of Agriculture and War Food Administration, *A National Policy for Fertilizers and Liming Materials*: February 1945, 11 pp.

Salient statistics of nitrogen compounds in the United States 1943-44 in short tons—
Continued

	1943	1944
Imports:		
Industrial chemicals:		
Anhydrous ammonia.....	5,863	-----
Ammonium nitrate.....	53,256	(9)
Fertilizer materials:		
Ammonium sulfate.....	99,827	103,628
Calcium cyanamide.....	125,634	101,886
Ammonium nitrate mixtures containing 20-percent or more nitrogen.....	2,895	317
Nitrogenous materials, n. s. p. f.....	63,372	112,085
Ammonium phosphates.....	43,987	91,943
Sodium nitrate.....	761,165	712,434
Sodium-potassium nitrate.....	19,767	9,407
Exports:		
Industrial chemicals:		
Anhydrous ammonia.....	1,983	3,623
Aqua ammonia.....	6,812	2,490
Ammonium nitrate.....	14,354	13,454
Fertilizer materials:		
Ammonium sulfate.....	78,005	10,615
Calcium cyanamide.....	-----	(9)
Nitrogenous chemical materials, n. e. s.....	8,395	11,178
Sodium nitrate.....	6,740	11,435

¹ Private plants, Tennessee Valley Authority and Defense Plant Corporation, at Lake Charles, La., only.

² War Production Board.

³ Bureau of Mines not at liberty to publish exact figures. Estimates by War Production Board—Cope.

W. C., Capacity to Produce Nitrogen Compounds: Chem. and Eng. News, vol. 23, Feb. 10, 1945, pp. 243-246

⁴ Not available.

⁵ Less than 1 ton.

POSTWAR OUTLOOK

The maximum prewar consumption of nitrogen in the United States, in agriculture and industry combined, appears to have been less than 540,000 short tons a year, with upward trends in evidence in both types of use. In postwar times these upward trends may continue. Increased wartime requirements brought the agricultural consumption to 623,000 tons of nitrogen in 1943-44, and the immediate postwar demand is expected to equal this, with an industrial demand probably exceeding 150,000 tons.

Exports of chemical nitrogen in prewar years rarely reached 50,000 tons a year; and in postwar times, in view of a world overcapacitated for nitrogen production, the exports can hardly be expected to exceed that level, except possibly in the first years after the war closes.

Imports in prewar times ranged between 100,000 and 265,000 tons a year, averaging about 185,000 tons annually during the last 2 decades. They came largely from Chile, but with considerable quantities from Canada and Europe. In the postwar period imports may have a somewhat similar range, with supplies coming from the same regions, but increased quantities possibly may come from Canada, with its new large war-built synthetic nitrogen industry.

The present large nitrogen production capacity of the Government synthetic and the commercial synthetic and by-product plants in the United States developed under inflated wartime conditions, plus net imports, will greatly exceed normal peacetime demands. The question of postwar utilization of this large excess, involving both national and international conflicts, is still under consideration.¹

¹ See, for example:

U. S. Department of Agriculture Interbureau Committee on Postwar Programs, *The Utilization of Government Synthetic Ammonia Plants for Fertilizer Production*; August 1944, 7 pp., diagrams. *Operation and Disposal of Synthetic Nitrogen Plants: Discussions with the Government of Chile*, U. S. Department of State Bull., Apr. 8, 1945.

Some excess Government capacity could be used in the postwar period for the production of agricultural nitrogen and at least part of the balance kept in stand-by condition as an integral part of the military establishment of the Nation.

INORGANIC NITROGEN COMPOUNDS

NATURAL NITRATES

Domestic nitrate deposits.—There has been no recent development of or output from any of the domestic deposits of natural nitrates so far as is known. Deposits of soluble nitrate minerals are widely distributed throughout the United States, but all of the known deposits are too small and low-grade to serve as a basis for a domestic nitrate industry. Many of the deposits have been studied and described; references to the various published reports are given in the Nitrogen Compounds chapter of Minerals Yearbook, 1942 (p. 1522).

Chilean nitrate.—Large quantities of natural sodium nitrate and much smaller quantities of sodium-potassium nitrate continue to be imported from Chile under a wartime subsidy whereby the United States Government absorbs some of the increased costs. These imports in recent calendar years are shown in the accompanying tables. The shortage of ships resulting from world-wide military and naval operations has been a bottleneck in the movement of Chilean nitrate to the United States. The War Shipping Administration has indicated that the shipping situation will continue to be uncertain. However, according to the War Production Board, it established in October 1944 an A-3 shipping priority for 850,000 tons of 16-percent Chilean nitrate of soda for the year ending June 30, 1945, considerably more than the reported 597,000 tons brought in during 1943-44 fertilizer year.

Losses of nitrate by enemy action in the Second World War during movement from Chile to the United States have been small.

In the First World War Chilean nitrate was used largely in the manufacture of munitions, but in the present world war the great bulk of the imports into the United States has been for the production of food and feed.

Imported sodium nitrate is under allocation, first under Order M-62 dated February 1, 1942, which was revoked December 26, 1944, when sodium nitrate was placed under Schedule 80 (Nitrogen Compounds) of General Allocation Order M-300 of the War Production Board. Imports of Chilean nitrate have been inadequate for full agricultural requirements. Consequently little has been allotted to mixed fertilizers in recent years. Its use in the eastern United States has been restricted to direct application to the soil as side and top dressings.

According to the Revised Maximum Price Regulation 205 of June 30, 1944, the maximum delivered price at any destination was \$30 per ton in bulk, \$33 in 100-pound bags, or \$32.40 in 167- or 200-pound bags, plus the lowest carlot rail freight rate per ton on the material to such destination from the nitrate port that has the lowest carlot freight rate to such destination.

For nitrate of soda-potash (minimum nitrogen content 14 percent) the maximum delivered price at any destination was \$38 per ton in

bulk, \$41 in 100-pound bags, or \$40.40 in 167- or 200-pound bags, plus the lowest carlot rail freight as defined above.

Nitrate of soda imported from Chile is stored in warehouses in various United States ports. Most of it is shipped from these ports to fertilizer manufacturers in carlots. However, at New York City, N. Y., Camden, N. J., and Baltimore, Md., it has been customary for some fertilizer manufacturers to take delivery by truck. Maximum prices for the imported nitrate of soda loaded on trucks at warehouses in these three cities was increased 50 cents per ton, effective November 16, 1944, by the Office of Price Administration.⁴

Retail prices of agricultural sodium nitrate were covered by Second Revised Maximum Price Regulation 135, as amended July 26, 1944, superseding Revised Maximum Price Regulation 108 (Nitrogenous Fertilizer Materials), which formerly covered sales of nitrogenous fertilizer materials to consumers.

Sodium nitrate imported for consumption in the United States, 1940-44

Year	Chile		Total		Year	Chile		Total	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1940.....	744, 145	\$12, 451, 179	744, 145	\$12, 451, 179	1943.....	761, 165	\$15, 188, 787	761, 165	\$15, 188, 787
1941.....	610, 561	10, 868, 222	610, 569	10, 868, 568	1944.....	712, 434	15, 304, 946	712, 434	15, 304, 946
1942.....	899, 090	17, 180, 780	899, 150	17, 183, 425					

Sodium-potassium nitrate (all from Chile) imported for consumption in the United States, 1940-44

Year	Short tons	Value	Year	Short tons	Value
1940.....	55, 016	\$1, 366, 131	1943.....	19, 767	\$580, 760
1941.....	34, 541	725, 846	1944.....	9, 407	278, 534
1942.....	14, 272	377, 703			

SYNTHETIC NITROGEN COMPOUNDS

General.—The general situation of the synthetic nitrogen industry in the United States in 1942 and 1943 was covered in the Nitrogen Compounds chapters in Mineral Yearbooks 1942 and 1943. The following summary presents the major developments in 1944.

Ammonia and certain other nitrogen compounds were under allocation by the War Production Board, General Preference Order M-163 covering byproduct ammonia; M-164, synthetic ammonia; M-62, sodium nitrate; and M-165, the remainder. All were in force throughout 1943 and up to December 26, 1944, when they were revoked. These compounds were then placed under General Allocation Order M-300, Schedules 79 (Synthetic Ammonia) and 80 (Nitrogen Compounds), as appendix B materials. The nitrogen compounds listed under Schedule 80 of December 26, 1944, were ammonium sulfate, sodium nitrate, ammonium nitrate (fertilizer grade), calcium cyanamide, ammonium phosphate (fertilizer grade), ammonium nitrate

⁴ Amendment 4 to Revised Maximum Price Regulation 205, Fertilizer Raw Materials, effective Nov. 16, 1944.

mixtures, mixed nitrogen solutions, B liquors, urea mixtures of 42 percent nitrogen (including "Uramon" but not including food grade urea).

On February 7, 1945, Schedule 80 was amended so as to substitute aqua ammonia (A, B, and C liquors) for B liquor.

Ammonia and its compounds.—The principal uses of ammonia have been military and agricultural. Minor quantities are consumed in industry. The surplus of ammonia above military demands, which appeared in 1943, continued into the first part of 1944 and agriculture benefited, but in the latter part of the year increased munitions requirements reduced the supply to agriculture.

Production of domestic byproduct-coke ammonia liquor (NH_3 content) was 31,665 short tons compared with 34,106 tons in 1943. Sales were 30,004 tons in 1944 as against 32,327 tons in 1943.

Ammonium sulfate, one of the principal sources of nitrogen in mixed fertilizers, is obtained solely as a manufactured product, and virtually all is used for fertilizer. Except for small quantities of synthetic origin the entire production in the United States comes from byproduct-coke operations. The byproduct output increased from 761,270 short tons in 1943 to 818,244 tons in 1944, whereas sales in 1944 were 776,962 tons compared with 774,815 tons in 1943. Stocks increased from 28,397 tons on January 1 to 69,031 tons at the end of the year.

Maximum prices of sulfate of ammonia, which were formerly governed by Maximum Price Regulation 205, are covered in the Revised Maximum Price Regulation 205 of June 30, 1944.

Ammonium nitrate was produced in both Government and private plants in 1944, and considerable quantities were imported from Canada. Production figures are not available. According to the United States Department of Agriculture, consumption in the 1943-44 fertilizer season for fertilizer purposes was approximately 300,000 tons. Curtailment of the supply for fertilizer purposes from Government nitrogen plants began in the summer of 1944, but deliveries from the Tennessee Valley Authority plant and from Canada continued. Munitions requirements were expected to preclude conversion of ammonia to ammonium nitrate for fertilizer by the Ordnance plants after November or December, leaving the Canadian plants as the principal source of supply during the remainder of the 1944-45 fertilizer year.

On February 1, 1944, distribution of ammonium nitrate being produced by the Army ordnance plants for use in the manufacture of fertilizer was placed in the hands of the Commodity Credit Corporation under an arrangement agreed upon by the War Production Board and the War Food Administration. The Commodity Credit Corporation in turn designated Associated Cooperatives, Inc., as its agent in the distribution of this material. This arrangement supersedes that in effect since November 1, 1943, under which Tennessee Valley Authority acted as distributor. According to report, a private company acts as distributor for the Canadian product.

The reduction in military needs freed large quantities of T. V. A. production for commercial distribution as fertilizer and also presented an opportunity for use of nitrogen fertilizers in test demonstrations in the program of T. V. A. and land grant colleges, according to the annual report of the T. V. A. for the year ended June 30, 1944.

Early in 1944 the price of ammonium nitrate produced by ordnance plants was established at \$50 a ton f. o. b. plant, plus freight charges from the nearest plant. In June the Associated Cooperatives, Inc., is reported to have announced 8- to 4-percent discounts from its basic price of \$50 a ton on fertilizer ammonium nitrate produced by T. V. A. and ordnance plants for June to September deliveries. Retail prices of ammonium nitrate are covered by Second Revised Maximum Price Regulations as amended July 26, 1944.

Higher maximum retail prices for a new Canadian grade of ammonium nitrate was announced by the Office of Price Administration in February 1945. In the northern and eastern sections of the country, where most of it will be used, this 33.5-percent nitrogen product will cost \$1.70 more per ton at retail than the old 32.5-percent grade. (Amendment 3 to Second Revised Maximum Price Regulation 135 as amended July 26, 1944, effective February 6, 1945.)

A detailed discussion of Canadian ammonium nitrate developments in recent years is given by MacRae,⁵ and the ammonium nitrate plant of the Welland Chemical Works, Ontario, Canada, is described in an article in Canadian Chemistry and Process Industries.⁶ The hazards in handling ammonium nitrate as a fertilizer are discussed by Davis,⁷ and the liability of fires and explosions of mixtures of ammonium nitrate and easily oxidizable substances; such as organic materials, are described by Davis and Hardesty.⁸

Sodium nitrate.—Little information is available regarding the current production or utilization of domestically produced synthetic sodium nitrate. According to the War Production Board, the output in the spring of 1944 was running at a rate of about 310,000 tons a year, but it is believed that the 1944 actual production greatly exceeded that figure.

According to the Revised Maximum Price Regulations No. 205, of June 30, 1944, of the Office of Price Administration, the maximum price that could be charged for domestically produced nitrate of soda (minimum nitrogen content, 16 percent) was \$27 per ton in bulk, \$30.05 per ton in 100-pound bags, or \$29.35 per ton in 167- or 200-pound bags, f. o. b. production point, provided that if and when this material is stored at Atlantic and Gulf nitrate ports by the seller, the maximum delivered price at any destination that may be charged shall be \$1 per ton higher than the above prices, plus certain specified freight rates. For nitrate of soda containing less than 16 units of nitrogen, the above maximum price shall be reduced at the rate of \$2 per unit.

Retail prices of agricultural sodium nitrate is covered by the Second Revised Maximum Price Regulation 135 as amended July 26, 1944.

ORGANIC MATERIALS

Because of restrictions in the use of chemical nitrogen in 1942 an increased demand for organic nitrogen-bearing fertilizers arose late in the year. To secure equitable distribution the War Food Ad-

⁵ MacRae, L. R., Canadian Wartime Ammonia and Ammonium Nitrate Programme: Canadian Chem. and Proc. Ind., vol. 28, No. 9, September 1944, pp. 592-596.

⁶ Canadian Chem. and Proc. Ind., vol. 28, No. 5, May 1, 1944, pp. 299-303.

⁷ Davis, R. O. E., Ammonium Nitrate, Hazards in Handling as a Fertilizer: Chem. and Met. Eng., vol. 50, No. 4, April 1944, p. 101.

⁸ Davis, R. O. E., and Hardesty, J. O., Organic Material and Ammonium Nitrate in Fertilizer Mixtures, Ind. and Eng. Chem., (ind. ed.), vol. 37, No. 1, Jan. 9, 1945, pp. 59-63.

ministration, on May 7, 1943, issued Food Production Order 12, effective May 1, 1943, banning purchase of these materials by fertilizer manufacturers without prior approval of the director of food production. On June 7, 1943, a revised food-production order, War Food Order 12, effective June 1, 1943, to July 1, 1944, was issued. This order limited the quantity of all such materials that could be used as fertilizer to 70 percent of the amount (in terms of nitrogen) acquired and used in the base period July 1, 1941, to June 30, 1942. Subsequently this percentage was raised to 80. On July 1, 1944, the War Food Administration revoked the broad general War Food Order 12 and issued in its place a restricted order, War Food Order 105, covering only edible oilseed meals or cake. Restrictions are retained on edible oilseed meals available for fertilizer because of heavy requirement for them for livestock feed. The new order also contained provisions governing the distribution for fertilizer use of edible type oilseed meals of inedible quality.

Calcium cyanamide (CaCN) is not produced in the United States, but is manufactured at Niagara Falls, Ontario, Canada, by North American Cyanamid, Ltd., at the only plant of its kind in the Western Hemisphere. It is marketed under the trade name Cyanamid. Considerable quantities are imported into the United States each year. The properties, reactions, and applications of this material are described in a recent article by Baughen.⁹ It has both agricultural and industrial uses. Formerly used almost entirely as a fertilizer, it has been supplanted to some extent by the introduction of direct methods of ammonia synthesis. However, its importance as a chemical raw material has increased.

⁹ Baughen, A. E., Properties, Reactions and Applications of Cyanamide: *Canadian Chem. and Proc. Ind.*, vol. 28, No. 12, December 1944, pp. 805-811.

MINOR NONMETALS

By G. RICHARDS GWINN ¹

SUMMARY OUTLINE

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GRAPHITE

Production and sales of domestic natural graphite decreased in 1944. The combined total of crystalline and amorphous graphite produced from domestic mines in 1944 was 5,408 short tons, compared with 9,939 tons in 1943; shipments reached 5,768 tons, valued at \$349,663, compared with 9,597 tons, valued at \$903,102, in 1943. Manufactured graphite was produced by the Acheson Graphite Division of the National Carbon Co., Inc., 30 East Forty-second Street, New York 17, N. Y., from a plant operated at Niagara Falls, N. Y. Stocks of crucible-grade graphite increased through 1944, and by the end of the year were sufficient for 15 months' supply at the current rate of consumption. On November 11, 1944, War Production Board Order M-61, controlling the allocation of graphite, was amended to remove crucible-grade graphite from the strategic class, leaving only Ceylon amorphous graphite, containing 95 percent graphitic carbon in lump or ground form, on the restricted list. The Ceylon material is used chiefly in the manufacture of batteries, and carbon brushes for electric motors in high-altitude bombers. Only the Ceylon material will meet the specifications for the type of carbon brush desired, and the total annual production of this grade—about 3,000 tons—is being divided almost equally between the United States and Great Britain.

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Graphite (natural and artificial) imported for consumption in the United States, 1940-44

Year	Crystalline				Amorphous				Total (natural and artificial)	
	Flake		Lump, chip, or dust		Natural		Artificial			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	6,551	\$340,396	752	\$54,027	23,766	\$487,675	260	\$9,187	31,329	\$891,285
1941.....	4,877	289,322	2,900	370,413	33,382	1,363,434	38	1,384	41,197	2,024,553
1942.....	6,031	412,919	4,152	601,150	33,569	1,480,079	169	4,739	43,921	2,498,887
1943:										
Canada.....	40	12,909	30	6,719	567	50,357	205	15,515	842	85,500
Ceylon.....	168	32,850	108	29,828	144	10,566	.....	.....	480	73,244
India and Depen- dencies.....	.....	.....	260	51,068	.....	.....	.....	.....	260	51,068
Madagascar.....	5,101	447,306	554	30,180	.....	.....	.....	.....	5,655	477,486
Mexico.....	.....	.....	.....	.....	21,679	270,877	.....	.....	21,679	270,877
Mozambique.....	2	317	.....	.....	.....	.....	.....	.....	2	317
	5,311	493,382	1,012	117,795	22,390	331,800	205	15,515	28,918	958,492
1944:										
Canada.....	105	28,969	80	18,733	640	51,734	131	10,299	956	109,735
Ceylon.....	.....	.....	1,303	207,599	222	35,493	.....	.....	1,525	243,092
Madagascar.....	6,086	634,262	155	25,500	.....	.....	.....	.....	6,271	659,762
Mexico.....	.....	.....	.....	.....	17,269	232,430	.....	.....	17,269	232,430
	6,191	663,231	1,568	251,832	18,131	319,657	131	10,299	26,021	1,245,019

As reported by the Graphite Branch of the War Production Board, approximately 67 tons of domestic flake, fines, and amorphous material were utilized in 1944 in the manufacture of crucibles, stoppers, sleeves, and nozzles.

In view of the favorable stock position of Madagascar flake at the end of 1944, a Government contract for 1945 was not signed, and Madagascar flake was released from public purchase at the end of the first quarter of 1945.

Under current manufacturing practice, domestic flake graphite alone may be used in the manufacture of crucibles up to Size 10 (capacity, about 25 pounds), but only 10 percent domestic flake can be used economically in large, foundry-size crucibles. The Bureau of Mines is conducting experimental work toward stabilizing the grade of the domestic material. It is hoped that with a more uniform product and refinements in crucible manufacture the quantity of domestic graphite suitable for use in crucibles will be increased.

Exports of natural graphite, 1940-44, were—1940: 1,632 short tons, valued at \$148,639; 1941: 1,723 tons, \$166,612; 1942: 4,095 tons, \$413,281; 1943: 3,010 tons, \$317,586; and 1944: 2,230 tons, \$248,257. The export market includes Mexico, United Kingdom, Argentina, Brazil, U. S. S. R., Venezuela, and the Central American countries.

The current market prices for domestic flake graphite in 1944 were as follows, in cents per pound: No. 1A, 14; No. 1, 13; No. 1B, 12; No. 2, 11; No. 3, 7; and No. 4, 5. Prices for Madagascar and Ceylon graphite in carlots, f. o. b. New York City, duty paid, in 1944 were, in cents per pound: Madagascar No. 1 Flake, 9 to 16; No. 2 Flake, 7 upward; Fines (ground) 55 to 70 percent carbon, 3 upward; Ceylon Lump, 10 to 12; Carbon Lump, 9 to 10; Chip, 7; and Dust, 4 to 5.

The postwar market for Madagascar and Ceylon material will remain steady. Requirements for Madagascar flake may be some-

what lower than the current demand, but demand for Ceylon amorphous 98-percent carbon may increase. Prices for Madagascar material are controlled by the French Government and at present are 15 to 20 percent higher than the 1943 figure. Ceylon prices are in a state of flux because of a Government investigation of graphite mining. It is believed that prices in these two islands in the postwar period will be comparable with the prewar prices. However, a definite statement cannot be made at present. The market and prices for domestic material will depend largely on the industry's willingness to improve and standardize the grade of its product.

Figures for total world production are not available. A table covering the period 1915-39 appears in Minerals Yearbook, Review of 1940 (p. 1414), and the following table includes all production figures that can be obtained for 1937-44.

World production of natural graphite, 1937-44, by countries, in metric tons¹

[Compiled by B. B. Waldbauer]

Country ¹	1937	1938	1939	1940	1941	1942	1943	1944
Argentina.....	25	28	.....	100	135	244	250	(²)
Australia:								
New South Wales.....				41	64	3	(²)	(²)
Queensland.....	12	10		63	320	225	(²)	(²)
South Australia.....	2				50	71	88	(²)
Tasmania.....				5	5		7	(²)
Western Australia.....				1	(²)	6	11	(²)
Brazil (exports).....	9		(²)	(²)	60	72	19	232
Bulgaria.....			23	50	(²)	(²)	(²)	(²)
Canada.....	4 2,675	4 1,044	4 1,199	4 1,381	4 905	4 463	1,726	1,420
Ceylon (exports).....	17,660	11,972	22,756	24,414	(²)	27,872	20,830	12,461
Chosen (exports).....	43,569	50,348	78,501	12,591	(²)	(²)	(²)	(²)
Czechoslovakia.....	5,144	(²)	(²)	(²)	(²)	(²)	(²)	(²)
Germany:								
Austria.....	18,158	16,852	(²)	(²)	(²)	(²)	(²)	(²)
Bavaria.....	23,544	28,106	(²)	(²)	(²)	(²)	(²)	(²)
Greenland.....	60	(²)	(²)	(²)	(²)	(²)	(²)	(²)
India, British.....	567	465	951	827	1,072	(²)	(²)	(²)
Indochina (exports).....		1	2	(²)	(²)	(²)	(²)	(²)
Italy.....	5,411	5,485	(²)	(²)	(²)	(²)	(²)	(²)
Madagascar.....	12,387	13,433	12,270	15,311	13,018	9,562	12,949	14,153
Mexico.....	11,210	9,611	9,815	12,327	16,928	20,811	20,677	12,977
Morocco:								
French.....	336	307	886	529	571	1,067	265	(²)
Spanish.....		73	(²)	352	414	888	226	51
Norway.....	3,638	3,802	4,333	(²)	(²)	(²)	(²)	(²)
Portuguese East Africa.....	(²)	(²)	(²)	(²)	(²)	165	428	(²)
Southwest Africa.....				71	188	181	1,758	1,973
Spain.....			54	353	23	251	136	(²)
Sweden.....	25	48	165	153	(²)	(²)	(²)	(²)
Union of South Africa.....	63	54	59	78	74	335	55	(²)
United States:								
Amorphous.....	(²)	(²)	(²)	(²)	(²)	} 6,459	9,016	4,906
Crystalline.....	(²)	(²)	(²)	(²)	(²)			

¹ In addition to countries listed graphite is produced in France, Japan, Nyasaland, and U. S. S. R., but production data are not available.

² Data not available.

³ Less than 1 ton.

⁴ Exports.

⁵ April to December, inclusive.

⁶ Bureau of Mines not at liberty to publish figures.

GREENSAND

Production of greensand by three companies in New Jersey in 1944 reached 7,896 short tons and shipments totaled 4,908 tons, valued at \$505,651; four companies in 1943 produced 13,003 tons and shipped 10,056 tons, valued at \$522,124.

All shipments in 1944, as in the previous year, were of refined material, which was used in water-softening compounds and water-purification agents.

Prices for refined greensand ranged from \$45 to \$65 per ton for water-softening compounds to \$130 to \$160 per ton for water purification. The relatively high total value of sales reported in 1944 is attributed to the large percentage of the material sold as a water-purification agent.

Statistics of greensand sold or used are presented in the following table.

Greensand marl sold or used by producers in the United States, 1940-44

Year	Short tons	Value	Year	Short tons	Value
1940.....	6,697	\$389,888	1943.....	10,056	\$522,124
1941.....	11,120	619,664	1944.....	4,908	505,651
1942.....	10,110	448,440			

KYANITE, ANDALUSITE, AND DUMORTIERITE

Domestic production and imports of the kyanite-group minerals decreased in 1944. However, supplies and stocks of imported kyanite were more than adequate for current requirements. The Government stock-pile objective of 5,739 short tons of Indian kyanite was reached by February 1944.

Domestic shipments, imports, new supply, and stocks of kyanite in the United States, 1940-44

Year	New supply						Stocks of Indian kyanite ¹	
	Domestic shipments		Imports		Total new supply			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	4, 241	\$93, 716	7, 658	\$92, 159	11, 899	\$185, 875	(²)	(²)
1941.....	8, 335	175, 581	14, 285	175, 218	22, 620	350, 799	(²)	(²)
1942.....	8, 708	190, 750	6, 524	93, 743	15, 232	284, 493	9, 485	\$449, 317
1943:								
British India.....			9, 972	105, 042	9, 972	105, 042	10, 883	515, 527
United States.....	9, 561	238, 649			9, 561	238, 649		
	9, 561	238, 649	9, 972	105, 042	19, 533	343, 691	10, 883	515, 527
1944:								
British East Africa.....			55	591	55	591		
British India.....			5, 680	66, 850	5, 680	66, 850	8, 618	409, 355
United States.....	(²)	(²)			(²)	(²)		
	(²)	(²)	5, 735	67, 441	(²)	(²)	8, 618	409, 355

¹ Industry and Government stocks as of December 31, as reported by Miscellaneous Minerals Division, War Production Board.

² Figures not available.

³ Bureau of Mines not at liberty to publish figures.

Imports during the first half of 1944 were about 50 percent below those of the previous year, chiefly because of rail-transportation delays and lack of shipping space, but they increased considerably during the latter half of the year as transportation difficulties eased.

Some coarse-grained kyanite from East Africa was received; but, although the chemical analysis was satisfactory, the material which broke down to a fine powder when calcined did not meet requirements of the ceramic and metallurgical industries for heavy-duty refractories.

Imports of 298 short tons of sillimanite valued at \$3,511 were received from New South Wales, Australia, and 48 tons valued at \$2,699 from Canada. The Canadian material presumably consisted of sillimanite concentrates produced in Canada from ore obtained in Australia.

The total supply of Indian kyanite in 1944 was 16,563 tons. Domestic consumption was 7,945 tons, leaving stocks of 8,618 tons of which 2,879 were in the hands of the industry and 5,739 in the Government stock pile.

The demand for Indian kyanite did not increase materially in 1944 over 1943, even though War Production Board Conservation Order M-143 had been revoked. This is attributed partly to the comparatively high cost and long life of kyanite refractories.

Domestic production of refractory and low-iron glass-grade kyanite in 1944 did not meet requirements because of the complete shut-down on January 5 of the Yancey Cyanite Co. operations at Burnsville, N. C., sole producer of the low-iron material, and of equipment and manpower shortages at the Kyanite Products Corp. plant near Farmville, Va. The latter corporation, only large domestic producer of refractory-grade kyanite, was purchased in February 1945 by the Kyanite Mining Corp. of Cullen, Va. Spodumene and topaz have been used as substitutes for glass-grade kyanite.

The cost of Indian kyanite delivered at Atlantic seaports in 1944 was \$54 per short ton. Prices for domestic kyanite are controlled by the Office of Price Administration under Order MPR-327. Prices set for the Kyanite Products Corp. of 61 Broadway, New York, ranged from \$24 per short ton for raw kyanite, 35-mesh, in carlots, to \$42.50 for 325-mesh material, less than carlots, in 100-pound bags; and for calcined kyanite from \$31.50 per short ton, 35-mesh, in carlots, to \$47.50 for 325-mesh material, less than carlots, f.o.b. Cullen or Pamplin, Va.

Production of andalusite at White Mountain, Mono County, Calif., by Champion Sillimanite, Inc., Merced, Calif., decreased slightly from the 1943 level. Production of dumortierite at Oreana, Pershing County, Nev., by the same company—only domestic producer of either mineral in 1944—also decreased. This material was shipped to the parent firm, Champion Spark Plug Co., Detroit, Mich., for use in spark plug cores, and other electrical porcelains.

The Bureau of Mines is investigating the possibilities of domestic production of sillimanite from deposits in Georgia, South Carolina, New Hampshire, and Idaho. The deposits in the Southern States consist of 20 bodies of sillimanite schist ranging in width from a few feet to 200 feet, which extend in a northeasterly direction from Talbotton, Ga., to Spartanburg, S. C., and appear more promising than the deposits in the Monadnock region of New Hampshire and those near Troy, Latah County, Idaho.

The postwar demand for Indian kyanite for heavy-duty refractories will remain strong unless a domestic deposit of kyanite or sillimanite is found which contains recoverable material in grain sizes similar to the Indian material (one-quarter inch to 35-mesh) or can be agglomerated to form a grog of a consistency comparable with the Indian material. Prices should be somewhat lower than the wartime figure when shipping rates are reduced to peacetime levels.

The market for domestic kyanite may show an increase because of improvements in mining and milling technique and because of the trend toward mixing kyanite and topaz to obtain a refractory product with a high pyrometric cone rating. Prices should be steady but may be influenced by the proposed change in southern freight rates.

LITHIUM MINERALS

Domestic production of the lithium minerals and compounds—spodumene, amblygonite, lepidolite, and dilithium sodium phosphate—reached an all-time high in 1944. The chief gain in tonnage was in spodumene, the output of which increased 87 percent over the 1943 total. However, percentagewise, the largest gain was in dilithium sodium phosphate, which increased 187 percent. The output of amblygonite and lepidolite was respectively 30 and 38 percent below the previous year's total. With the exception of lepidolite for the glass-making industry, for which we depended largely on material from Southwest Africa, the 1944 output of lithium minerals was adequate for all requirements.

The Solvay Process Co. plant at Kings Mountain, N. C., although not reaching maximum output, was the major producer, followed by the Black Hills Tin Co. at Tinton, S. Dak. The latter plant, however, operated only from February through August 1944. A new lepidolite producer—the Hayden Mining Co. of Colorado Springs, Colo.—began operations on the Brown Derby Claims in Gunnison County in June 1944. The increased output of dilithium sodium phosphate is attributed to the installation of a flotation process at Searles Lake, Calif., by the American Potash & Chemical Corp. By July 1944 domestic production of spodumene and dilithium sodium phosphate had exceeded requirements, and the excess was shipped to the Government stock pile. On September 30, 1944, General Conservation Order M-253 of the War Production Board, controlling the allocation of spodumene effective December 5, 1942, was revoked. Most of the Army contracts expired December 31, 1944, and have not been renewed; as a result, the Solvay Process Co. plant at Kings Mountain ceased production temporarily in February 1945.

Shipments of lithium ores and compounds from 1940 through 1944 are shown in the following table. An approximate figure for the total Li_2O content, obtained from the average Li_2O percent of the ore reported by the producers, is also included.

Shipments of lithium ores and compounds from mines in the United States, 1940-44

Year	Ore (short tons)	Value	Li_2O (short tons)	Year	Ore (short tons)	Value	Li_2O (short tons)
1940.....	2,011	\$80,679	113	1943.....	8,155	\$314,660	463
1941.....	3,832	115,718	209	1944.....	13,319	552,977	848
1942.....	5,405	243,516	299				

Prices for lithium ores produced in the United States for sale on the open market, as quoted by E&MJ Metal and Mineral Markets in 1944 were as follows: Spodumene, \$5 to \$6 per 20 pounds of contained lithia (Li_2O), 6 percent minimum, \$30 per short ton, in carlots; amblygonite, 8 to 9 percent (Li_2O), \$40 to \$50 per short ton, f. o. b. mine; and lepidolite, 3 percent (Li_2O), \$24 to \$25 per short ton, f. o. b. mine.

By October 1944 the United Nations had succeeded in cutting off the supplies of amblygonite to Germany from Spain and Portugal. Shipments of amblygonite from Spain reached 105 metric tons in 1943 and 70 tons in January to October 1944.

Markets for lithium ores and compounds are expanding rapidly. However, because wartime restrictions on purchase of machinery have prevented the Solvay Process Co. from completing its milling unit at the Kings Mountain (N. C.) plant and because many of the postwar uses will be new, it is not possible at this time to forecast postwar prices and markets for lithium minerals.

MINERAL EARTH PIGMENTS AND MANUFACTURED IRON OXIDE PIGMENTS

[Prepared by Charles L. Harness]

Heavy demand for military uses kept several of the synthetic iron oxides in very tight supply during much of 1944, but the natural earth pigments (except ochers and natural yellows) were generally available despite a manpower shortage which closed many deposits and curtailed processing. Iron oxide pigments are now used mostly in military and essential industrial paints, but in normal times there is a substantial consumption in house and barn paints and in linoleum, mortar colors, chicken feed, and glass polishing.

Statistics of production and foreign trade are presented in the following tables.

Natural mineral pigments and manufactured iron oxide pigments sold by processors in the United States, 1943-44, by kinds

Pigment	1943		1944	
	Short tons	Value	Short tons	Value
Mineral blacks.....	3, 428	\$104, 369	3, 388	\$94, 192
Precipitated magnetic blacks.....	1, 602	271, 516	1, 110	191, 238
Natural brown oxides (metallic browns).....	7, 114	337, 514	7, 201	329, 721
Vandyke brown (finished pigment).....	1 185	1 26, 378	1 162	19, 658
Sap brown.....	1 264	1 50, 487	453	98, 095
Pure browns (96 percent or better iron oxides).....	818	163, 122	1, 025	195, 281
Natural red oxides.....	23, 703	874, 363	19, 267	795, 895
Pure red oxides (98 percent or better Fe_2O_3).....	10, 239	1, 791, 964	9, 948	1, 788, 136
Venetian reds.....	6, 873	513, 421	8, 184	595, 556
Pyrite cinder.....	883	53, 670	494	31, 561
Other red iron oxides.....	4, 621	421, 423	6, 339	557, 505
Natural yellow oxides (high Fe_2O_3).....	5, 017	179, 099	4, 403	157, 911
Pure yellows (85 percent or better Fe_2O_3).....	14, 833	2, 060, 636	16, 082	2, 210, 436
Ochers (low Fe_2O_3).....	9, 246	344, 198	9, 547	332, 946
Siennas:				
Burnt.....	818	110, 313	762	100, 870
Not burnt.....	1, 891	210, 132	2, 314	280, 824
Umbers:				
Burnt.....	1, 759	85, 437	1, 854	96, 513
Not burnt.....	4, 290	132, 744	4, 126	120, 242
Other.....	2, 632	220, 291	359	19, 970
	1 100, 216	1 7, 951, 057	97, 018	8, 016, 452

1 Revised figure.

Natural mineral pigments and manufactured iron oxide pigments sold by processors in the United States, 1943-44, by States where processed

State where processed	1943		1944	
	Short tons	Value	Short tons	Value
California.....	8,918	\$432,181	(1)	(1)
Georgia.....	5,010	105,910	6,216	\$128,659
Pennsylvania.....	40,906	3,106,154	34,995	3,035,145
Other States ²	50,382	4,306,812	55,807	4,852,648
	100,216	7,951,057	97,018	8,016,452

¹ California included under "Other States" in 1944.

² Arkansas, Illinois, Maryland, Michigan, New Jersey, New York, North Dakota, Ohio, Tennessee, Virginia, and Wisconsin.

³ Revised figure.

Dry ochre, sienna, umber, and other forms of iron oxide for paint exported from the United States, 1941-44, by countries

Country	1941		1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Argentina.....	325	\$44,906	50	\$9,043	34	\$7,510	19	\$5,837
Bolivia.....	3	1,801	5	1,022	25	6,999	10	1,414
Brazil.....	243	35,319	108	22,188	66	15,105	249	54,287
Canada.....	3,006	200,427	2,364	151,109	2,660	198,296	3,333	194,489
Chile.....	91	14,486	59	10,868	80	18,776	90	19,656
Colombia.....	124	24,751	97	26,857	165	39,401	137	30,777
Cuba.....	172	21,872	359	33,681	314	44,751	238	32,198
Curaçao (N. W. I.).....	7	915	12	1,517	58	29,077	10	937
Mexico.....	210	39,411	153	32,902	283	59,426	220	44,004
Netherlands Indies.....	137	25,099	27	4,830	1	144		
United Kingdom ¹	20	8,696	1	224				
Venezuela.....	161	19,264	100	16,112	94	18,649	112	17,407
Other countries.....	441	55,359	206	52,304	580	66,674	741	83,844
	4,940	491,806	3,631	362,657	4,870	504,810	5,159	484,850

¹ United Kingdom of Great Britain and Northern Ireland.

Selected mineral pigments imported for consumption in the United States, 1941-44, by countries

Pigment	1941		1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Iron oxide pigments:								
Natural.....	6,196	\$232,924	1,936	\$60,405	581	\$22,051	1,494	\$61,231
Synthetic.....	2,321	290,162	1,978	250,779	800	92,966	686	86,188
Ochre, crude and refined.....	380	11,717	477	12,036	78	1,810	4	221
Umbre, crude and refined.....	31	1,579	5	169			1,172	31,569
Vandyke brown.....	3	185	(1)	43				
	8,931	536,567	4,896	323,422	1,459	116,827	3,356	179,239

¹ Less than 1 ton.

Prices of finished earth pigments, which are quoted in cents per pound, were generally unchanged during 1944, according to the Oil, Paint, and Drug Reporter. Precipitated magnetic blacks, in barrels, less carlots, works, were quoted at 8½; metallic browns were 2½ in barrels; Vandyke brown sold at 9 (special grade at 12), and sap brown crystals at 12; synthetic (pure) browns, 12; synthetic (pure) red iron oxides, 9 to 9½; Venetian reds, 2.2 to 4, depending on iron oxide content; natural yellow oxides, high iron, 5; synthetic (pure) iron oxide yellows, 7.1; domestic French-type ochers, 3.45; burnt siennas, American type, were quoted over a range of 3½ to 5; Italian type burnt siennas, 8¼ to 10¼; raw siennas, American type, ranged from 4 to 10; raw siennas, Italian type, 8 to 10; Turkey-type umbers were quoted at 4¼ to 5¼, depending on quality and point of purchase.

After the war, according to trade reports, precipitated yellow iron oxides will continue to hold most markets formerly enjoyed by French ochers. Satisfactory replacements have been found for raw Italian ochers but not for burnt types. Likewise, umbers from the Island of Cyprus and red oxide from the Persian Gulf have not been equaled and will probably find a ready postwar market here. Although several excellent replacements for Spanish red oxide have been reported, its cheapness and relative availability have kept it in fair demand. Some domestic Vandyke brown producers expect to go out of business when cheaper German grades are again available.

MINERAL WOOL

Mineral-wool production in 1944 reached 568,296 short tons, valued at \$54,482,796, an increase of 16,772 tons in quantity and \$10,812,086 in value over 1943. Production in 1944 came from 38 companies operating 51 plants in 19 States, compared with 40 companies operating 53 plants in 19 States in 1943.

The production of both home and industrial insulation increased. The change in the industrial field is attributed to the increased requirements of the armed forces for mineral-wool insulation products on ships, aircraft, tanks, and other military equipment, and the realization by industry that complete insulation is necessary to maintain maximum efficiency and production during the war period. The large increase in dollar value is attributed to the amendment of Order A-2 of Maximum Price Regulation 188, effective from September 16, 1943, granting relief to mineral-wool manufacturers to cover increased manufacturing costs, and to the larger production of the relatively higher-cost industrial insulation. Prices in 1944, per short ton, in carlots f. o. b. plant, were \$37.50 for loose and \$53 for granulated wool, compared with \$30 and \$45, respectively, in 1943.

The postwar market for mineral-wool insulation will be strong. However, with the increased use of lightweight glass insulation more emphasis will be placed on the density per cubic foot of the finished product. Because of the bulk of most mineral-wool products, which prohibits haulage over great distances, prices are controlled largely by local conditions, and it is difficult to estimate price conditions for the industry as a whole. It is believed, however, that postwar prices for loose and granulated mineral wool, f. o. b. plant, will approximate the 1943 figures.

Production of mineral wool in the United States, 1943-44, by products

[Compiled by Anne L. Marks]

Product	Home insulation		Industrial insulation		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1943						
Loose wool (sold as such).....	62,978	\$1,720,375	6,600	\$191,564	69,578	\$1,911,959
Granulated wool (sold as such).....	277,833	10,257,797	6,704	219,975	284,537	10,477,772
Bats.....	56,737	4,386,006	3,416	659,799	60,153	5,045,805
Rolls.....	10,117	541,256	65	2,819	10,182	544,075
Felt.....	6,781	791,781	34,764	5,236,679	41,545	6,028,460
Blocks.....	453	40,960	11,068	1,900,450	11,521	1,941,410
Boards.....			26,013	12,495,640	26,003	12,495,640
Mineral-wool insulating cement.....	3,432	238,006	18,839	1,230,681	22,271	1,468,687
Blankets.....	402	68,862	9,111	1,246,908	9,513	1,315,770
Pipe covering.....	11	1,522	6,875	1,443,969	6,886	1,445,491
Other.....	4,029	91,024	5,306	904,617	9,335	995,641
	422,773	18,137,589	128,751	25,533,121	551,524	43,670,710
1944						
Loose wool (sold as such).....	59,787	1,609,235	5,410	188,876	65,197	1,798,111
Granulated wool (sold as such).....	308,441	11,344,433	5,178	160,509	313,619	11,504,942
Bats.....	52,007	3,633,878	7,446	1,293,245	59,453	4,837,123
Rolls.....	6,394	372,938	565	30,955	6,959	403,893
Felt.....	4,683	427,393	38,998	5,154,208	43,681	5,581,601
Blocks.....			14,633	1,927,618	14,633	1,927,618
Boards.....			36,728	24,635,485	36,728	24,635,485
Mineral-wool insulating cement.....	1,823	135,861	10,695	825,906	12,518	961,767
Blankets.....	1	148	7,353	1,021,819	7,354	1,021,967
Pipe covering.....			5,240	958,692	5,240	958,692
Other.....	1,344	54,921	1,570	796,676	2,914	851,597
	434,480	17,578,807	133,816	36,903,959	568,296	54,482,766

MONAZITE

Imports of monazite sand, the only commercial source of the rare-earth elements, decreased 92 percent in quantity and 94 percent in value in 1944 compared with 1943. They were obtained entirely from India. Consumption, as reported by the War Production Board, was also lower in 1944 when 1,990 short tons were processed, compared with 2,075 tons in 1943, a decline of 4 percent. The decrease in imports is attributed partly to the low shipping priority given this material and the reduction in number of ships sent to India during the year. The Government stock pile—3,262 short tons—was completed by the end of May 1944. Industry stocks decreased in 1944 but were still sufficient for more than 2 years' supply at the current rate of consumption.

Monazite is consumed in the production of ferrocenium and numerous chemical compounds. Rare-earth oxides and fluorides are used as cores in carbon-arc electrodes for searchlights, moving-picture projectors, and floodlights. Rare-earth oxides are used as a glass-polishing compound, and rare-earth hydrates and cerium hydrate are required in the manufacture of special optical glass.

The war has brought a definite change in the specifications for monazite sands. The current basis for valuing monazite sands is the rare-earth oxide content contrasted with the prewar requirement for an 8-percent thoria content in the material. Most of the new uses are directly connected with the prosecution of the war, and although many have postwar possibilities it is difficult at this time to evaluate future markets and prices.

Monazite sand and other thorium ore¹ imported for consumption in the United States, 1940-44, by countries

Country	1940		1941		1942		1943		1944	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Brazil.....	201	\$7,440	734	\$25,240	1,346	\$62,555	1,911	\$88,548	-----	-----
India and Depend- encies.....	2,766	92,387	2,714	82,068	3,052	112,928	3,033	128,379	384	\$13,782
United Kingdom ²	-----	-----	-----	-----	-----	-----	36	8,553	-----	-----
	2,967	99,827	3,448	107,308	4,398	175,483	4,980	220,480	384	13,782

¹ Quantities are gross weight; monazite content not reported.

² United Kingdom of Great Britain and Northern Ireland.

OLIVINE

Shipments of olivine from North Carolina decreased to 3,270 short tons valued at \$35,207 in 1944, from 5,415 tons valued at \$48,633 in 1943. The entire production in both years was consumed in refractories. Prices for crude olivine, f. o. b. North Carolina, were quoted at \$5 to \$7 per short ton; ground olivine, 200-mesh, \$17, and 20-mesh to dust, \$12 per ton.

It is expected that the postwar market for olivine will remain essentially at the prewar level. Prices, which have been affected very little by the war should remain virtually at the current level. However, if the west-coast steel plants continue to operate or expand, a market for olivine in the Twin Sisters Mountain region of Washington may develop.

RADIO-GRADE QUARTZ

Domestic production of radio-grade quartz in 1944, as reported by the War Production Board, was 3,934 pounds valued at \$23,769, compared with 5,968 pounds valued at \$25,598 in 1943.

Imports of quartz crystal for use in the manufacture of piezoelectric quartz plates for radio, telephone, and detection equipment reached 2,300,506 pounds valued at \$11,178,643 in 1944, of which 1,658,000 pounds (72 percent) was of radio grade. Corresponding figures for 1943 were 3,356,000 pounds valued at \$11,409,803, of which 1,825,000 pounds (54 percent) met specifications for radio-grade material. Except for 2,156 pounds obtained from Angola, Chile, Colombia, Cuba, Ecuador, Guatemala, and Portuguese Guiana, the entire imported supply was received from Brazil. Private importers obtained 81 percent of the total imports, and the remainder was purchased by the Metals Reserve Company.

The total new supply of radio-grade quartz in the United States in 1944, therefore, was 1,661,934 pounds.

The total number of finished plates produced in 1944 reached 29,939,000 and comprised 29,766,000 radio oscillators, 153,000 telephone resonators, and 20,000 other types of plates (as reported by the Miscellaneous Minerals Division of the War Production Board). This represents an increase of 33 percent over the 1943 figure of 22,576,150 plates—22,486,200 oscillators, 65,595 telephone plates, and 24,355 other types. The average number of plates obtained per pound of usable quartz in 1944 was 17. This increase in number of

plates produced in 1944 is attributed largely to improvements in technique that have made possible the utilization of material previously rejected and to an increase from 54 to 72 percent in the ratio of radio-grade material to total quartz crystal imported.

The value of the radio-grade quartz consumed annually has reached the point where crystal production is almost too large to be called a minor-nonmetal industry. This increase has come primarily from expansion of Brazilian production and was accomplished largely by United States Government assistance in mechanizing many of the producing properties and by a price stimulation that has not been controlled by specific OPA orders. An energetic program of conservation, substitution, scrap recovery, and research, also established by the Government, late in 1942, has resulted in the discovery of the usability of large quantities of material previously considered unsatisfactory. Our consumption and stock-piling programs could not have been met without the integration of these Government programs carried out in Brazil and the United States.

The most important recent development of the research program is the X-ray method of irradiation perfected by Reeves Sound Laboratories, Inc., whereby frequencies of oscillator plates may be adjusted downward from their original values. Thus, plates overshot in frequency during manufacture or that have gone over frequency due to aging, recleaning, or underplating may be recovered provided the desired frequency change is within the range of radiation technique.

The sale of imported quartz crystals by private importers and Government agencies was brought under control of the General Maximum Price Regulation of the Office of Price Administration on July 15, 1944, by Amendment 64 to Revised Supplementary Regulation No. 1. This amendment revoked the exemption of imported commodities sold to agencies, contractors, or subcontractors of the United States or Allied Governments. The amendment provides that the Metals Reserve Co. maximum prices for quartz crystals shall be the prices set out in its current price schedule of February 18, 1944.

General Conservation Order M-146 of the War Production Board was amended during 1944 to increase the number of permitted uses of quartz crystals because of an easier supply : demand ratio. Before March 20, 1944, crystals could be used only in the manufacture of radio oscillators and filters for war purposes and a few other military items. In addition to these uses, they may now be used for radio oscillators and filters for Government activities directly connected with defense, public health, welfare, or security; for commercial broadcasting stations and communication systems; and in the manufacture of optical or electrical parts for use in research or production instruments manufactured to fill orders rated AA-2X or higher.

Because attempts at domestic production were relatively unsuccessful, the Metals Reserve Company ceased purchasing domestic material at the end of 1944.

Brazilian quartz crystal is recovered from four types of deposits: Veins, blanket replacement, pegmatites, and residual or placer. The largest percentage is obtained from vein and blanket-replacement deposits. Production comes primarily from four States: Minas Gerais, 35 percent; Goiaz, 30 percent; Bafa, 25 percent; Esperito

Santo, 5 percent; others, 5 percent. The average deposit produces about 1 ton of usable material per month, and the ratio of marketable to unmarketable quartz ranges from 1 : 3,500 in the better deposits to a low of 1 : 100,000 in the leaner mines.

Small quantities were recovered and shipped from Madagascar to England in 1944; the crystals from this island are found largely in caverns in quartzite. It is reported that a deposit of radio-grade quartz which covers 20 square kilometers was discovered in the Central Urals of Russia at Khaibullinsk in 1943; operations began in the same year.

Government buying prices established August 4, 1943, did not change during 1944. They ranged for faced quartz from \$1.95 for third-grade material weighing 0.44 to 0.66 pound to \$36.95 for first-grade material, 60 to 100 percent usable, weighing 22 pounds or above; \$1.56 to \$33.25, respectively, for unfaced quartz; and \$1.60 to \$2.40 for small material, which must be faced, weighing 0.22 to 0.44 pound. The complete table is contained in minerals Yearbook, 1943 (p. 1586).

The demand for radio-grade quartz in communication and detection devices will continue at a high rate in the postwar period. It seems probable also that the United States and the rest of the world will depend primarily on the Brazilian deposits. However, with the advances in manufacturing technique, and the expected release to the open market of a greater quantity of the larger and better-grade material, which during the war has been largely allocated to Great Britain, it is believed that adequate supplies for all countries will be available. The price structure will be controlled, at least partly, by the economic policies of the Brazilian Government, which at present is requesting equipment to process the raw materials into the finished plates. It may well be, therefore, in the postwar period, that purchasers of radio-grade quartz may be required to obtain a part of their supply in finished plates. If so, the price for radio-grade quartz will be higher than the current wartime figure.

STRONTIUM MINERALS

[Prepared by Charles L. Harness]

Requirements for celestite (natural strontium sulfate) in signal flares and tracer bullets declined sharply in 1944, and activity in the domestic industry was maintained chiefly by a demand for well-drilling weight material that could not be supplied by barite producers. Small quantities of domestic celestite were sold for the purpose of adsorbing iron from caustic-soda liquors and for making strontium chemicals.

Shipments of celestite by producers totaled 3,005 short tons valued at \$48,165 in 1944 compared with 7,566 tons valued at \$114,526 in 1943. Imports for consumption were 5,793 short tons valued at \$86,419 in 1944 compared with 16,881 tons valued at \$249,580 in 1943. Mexico was the chief supplier in both years. Consumption of all celestite in strontium chemicals amounted to about 6,000 tons in 1944 compared with 13,387 in 1943.

The following producers shipped celestite in 1944: Milwhite Co., Inc., Cotton Exchange Building, Houston, Tex., deposit near Blanket,

Brown County, Tex.; Bennett-Clark Co., Inc., Box 951, Nacogdoches, Tex., deposit in Nolan County, Tex.; Pan-Chemical Co., 205 First National Bank Building, Pomona, Calif., deposit in the Fish Mountains of Imperial County, Calif.; and W. C. Buehler and W. N. Rowe, 1555 Sunset Avenue, Pasadena, Calif., deposit near Ludlow, Calif.

The price of celestite delivered in the Philadelphia area was about \$30 in 1944, the same as in 1942 and 1943.

The domestic industry has little prospect of continued activity after the war. For high-grade uses the impure Texas celestite cannot compete with 92-percent material available in Mexico, Spain, and England. California celestite can compete in analysis but not in freight costs. The lower-grade domestic celestites are satisfactory as drilling mud, but after the war they probably will be unable to compete with celestite from England, which may be available at prices as low as \$15 a short ton ex docks Philadelphia.

TOPAZ

Production and sales of topaz in 1944, as in 1943, by the United Feldspar & Minerals Corporation of Spruce Pine, N. C., from the Brewer mine, near Kershaw, S. C., exceeded the previous year's total. Topaz was used as a substitute for fluorspar by some steel companies and has been found to be the most useful of all fluorine-bearing minerals employed in making leadless glaze, as it gives off its fluorine at a temperature somewhat under the maturing temperature of the glaze.

Tests at the Wilson Dam Laboratory of TVA on the calcination and defluorination of topaz in a rotary kiln for use as a substitute for Indian kyanite in the manufacture of high-aluminum, mullite-type refractories has produced encouraging results.²

Domestic topaz and kyanite have been used at the Bureau of Mines Electrotechnical Laboratories, Norris, Tenn., in the manufacture of a lightweight superduty brick that meets not only the A. S. T. M. shrinkage requirements in reheat tests but also the more severe Navy reheat specifications. Additional research is now in progress to prevent press cracks and warping during firing.³

A larger market for topaz may result from these and similar investigations now in progress at the Bureau of Mines and TVA laboratories and experiment stations.

² Pole, G. R., Calcination of Topaz Ore in a Rotary Kiln: Jour. Am. Ceram. Soc., vol. 27, No. 6, 1944, pp. 181-185.

³ Galbreath, W. W., McVay, T. N., and Allen, D., Lightweight Superduty Kyanite-Topaz Refractory: Jour. Am. Ceram. Soc., vol. 27, No. 8, 1944, pp. 241-246.

VERMICULITE

Sales of cleaned and screened vermiculite in 1944 increased 7,471 short tons (16 percent) above the 1943 total and approached very closely the all-time high of 57,848 tons in 1942.

The bulk of the production in 1944, as in previous years, came from the Universal Zonolite Insulation Co. mine at Libby, Mont. Several new companies carried on development in Colorado in 1944 and expected to produce early in 1945. A report on the Wyoming vermiculite deposits by Arthur F. Hagner,⁴ including information on occurrence, physical properties, specifications, and production, was released by the State geological survey in March 1944; and a review of the South African deposits, including material on preparation and uses and a flow sheet of an exfoliating plant, has been published.⁵

Fire-retardant qualities of vermiculite plaster on metal lath-wood stud partition and steel floor construction with vermiculite-plaster ceiling and vermiculite-concrete top floor were tested by Underwriters Laboratories, Inc., of 207 East Ohio Street, Chicago, Ill., in August and September 1944. Under test conditions, the vermiculite products in the two units delayed 1 and 4 hours, respectively, the spread of the flames from one portion of the building to another.

Two new agricultural uses have been reported for exfoliated vermiculite—as a seed starter in place of peat moss and as an agricultural mineral admixture that acts as a subirrigation and mulching agent, to improve garden and lawn soil.

The quantity of vermiculite consumed in refractory products and in cement continues to expand.

Production figures for domestic mines from 1940 through 1944 follow. A table covering the period 1924–39 appears in *Minerals Yearbook, 1940* (p. 1480).

Screened and cleaned vermiculite sold or used by producers in the United States, 1940–44

Year	Short tons	Value	Year	Short tons	Value
1940.....	22, 299	\$137, 698	1943.....	48, 645	\$471, 595
1941.....	23, 438	125, 444	1944.....	54, 116	541, 744
1942.....	57, 848	319, 931			

Screened vermiculite brings \$8 to \$12 a short ton, f. o. b. mine. However, most of the material reaches the consuming market in the exfoliated form. The price for exfoliated vermiculite is quoted at 70 cents to \$1.25 per bag, each bag containing 4 cubic feet weighing 25 pounds, or \$56 to \$100 a short ton, f. o. b. works. Assuming a value of \$75 a ton for exfoliated material and a 10-percent loss in volume on exfoliating, the value of sales of exfoliated material in 1944 would be approximately \$3,652,800.

⁴ Hagner, A. F., *Wyoming Vermiculite Deposits*: Wyoming Geol. Survey Bull. 34, 1944, 47 pp.

⁵ Laschinger, J. E., *Vermiculite Technology*: Min. Jour. (London), vol. 223, No. 5689, 1944, pp. 567–569, No. 5690, 1944, pp. 581–582.

Wartime conservation of fuel has not only increased the uses and value of insulating materials but also has been instrumental in lowering the weight specifications for these materials. It seems probable therefore, in view of the lighter weight of glass wool and some rock-wool insulation products, that the postwar market for exfoliated vermiculite will be largely in the field of lightweight aggregate for concrete and structural and refractory uses. Prices for cleaned and screened vermiculite have not changed materially during the war and should not fluctuate greatly in the postwar years.

WOLLASTONITE

Production and sales of wollastonite in 1944 from the Burnham property near Willsboro, N. Y., exceeded the 1943 total. In March 1945 the deposit was leased to the Titanium Alloy Manufacturing Co., 111 Broadway, New York 6, N. Y. As industrial uses for this material are expanding, an enlarged postwar market is anticipated.

PART IV. MINE SAFETY

EMPLOYMENT AND ACCIDENTS IN THE MINERAL INDUSTRIES

By FORREST T. MOYER

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SUMMARY

The down trend in the number of men working in the mineral industries continued throughout 1944, and total employment for the year fell to an estimated 693,800 men, a decline of 9 percent from 1943. The falling-off in mineral industry employment intensified the acute shortage of manpower and held back production of newly mined material in some mineral industries, notably in mining of fuels and certain metals and nonmetals. Unrestricted demand for nearly all mineral products was extremely high but could not be realized because war controls permitted the meeting only of war and "essential" civilian demands and severely restricted "nonessential" civilian needs for all mineral products. In the coal-mining and byproduct-coke industries, however, demand increased in the face of a steadily dwindling number of workers, and the labor-supply problem became more and more serious through 1944. Production in the coal industry was increased only by lengthening the working day and by working more days during the year.

The total man-hours of productive work in the extractive industries, which had gained appreciably in each year since 1938, turned downward in 1944, and the yearly total of slightly more than 1½ billion man-hours was 2 percent below 1943. The time worked in 1944 was lower than in 1943 in each of the mineral industries except coal mining and byproduct-coke production. The aggregate man-days of work in the mineral industries fell 7 percent below 1943, a sharper decline than occurred in man-hours owing principally to the reduction in number of employees.

Although the war-controlled demand for some minerals was off somewhat from 1943, production had to be maintained at high levels in many mineral industries. This was accomplished with a reduced labor force by increasing the number of workdays to 285 as an average for all industries in 1944 compared with 279 in 1943. A second means of meeting requirements was to lengthen the workshift, which advanced from an average of 7.55 hours per day in 1943 for all industries to 7.94 hours per day in 1944. As a result, the average employee in the mineral industries worked 2,264 hours during 1944 compared with a corresponding total of 2,104 hours in 1943.

EMPLOYMENT AND ACCIDENTS IN THE MINERAL INDUSTRIES 1549

Number of men working¹ in the mineral industries of the United States, 1942-44

	1942	1943	1944 ²
Coal mines:			
Bituminous.....	448,797	407,135	380,000
Pennsylvania anthracite.....	82,064	79,381	77,500
	530,861	486,516	457,500
Metal mines:			
Iron.....	28,956	29,636	26,200
Lead-zinc (Mississippi Valley) ³	8,111	9,201	7,300
Copper.....	23,222	23,700	18,500
Gold and silver lode mines (including lead, zinc, and copper, except as listed above).....	23,029	14,885	11,400
Gold placer mines.....	8,417	1,398	800
Miscellaneous (tungsten, manganese, etc.).....	8,034	9,229	5,000
	99,769	88,049	69,200
Nonmetal mines⁴:	12,677	12,703	11,900
Quarries:			
Cement.....	30,235	25,811	20,600
Marble.....	2,205	1,540	1,400
Slate.....	2,284	1,255	1,200
Traprock.....	3,114	2,256	2,000
Granite.....	6,307	4,646	4,100
Sandstone.....	2,840	2,441	2,100
Limestone.....	26,629	21,742	19,100
Lime.....	10,656	10,186	9,000
	84,270	69,877	59,500
Coke ovens:			
Byproduct.....	19,551	21,632	21,600
Beehive.....	4,358	4,133	3,100
	23,909	25,765	24,700
Metallurgical plants:			
Ore dressing mills and auxiliary works.....	19,349	24,267	23,400
Smelters and auxiliary works.....	31,805	56,143	47,600
	51,154	80,410	71,000
Grand total.....	802,640	763,320	693,800

¹ Figures represent summation of reports for individual mines showing daily average number of employees at each mine on days when mine was in operation.

² Subject to revision.

³ Grouping of data revised by transfer of figures for fluorspar in Kentucky and Illinois from "lead-zinc (Mississippi Valley)" classification to "Nonmetal mines" classification.

⁴ Revised figure.

Employment and accident records of mineral industries of the United States, 1934-44

Year	Men working	Man-days worked	Man-hours worked	Number		Rate per million man-hours	
				Killed	Injured	Killed	Injured
1934.....	739,817	144,566,133	1,081,694,716	1,429	81,660	1.32	75.49
1935.....	783,139	152,354,170	1,128,898,465	1,495	82,219	1.32	72.84
1936.....	824,514	177,920,334	1,326,347,029	1,686	92,644	1.27	69.85
1937.....	859,951	186,790,283	1,381,291,415	1,759	96,494	1.27	69.85
1938.....	774,894	145,056,875	1,069,729,725	1,369	71,618	1.28	66.95
1939.....	788,925	159,388,490	1,169,351,467	1,334	75,495	1.14	64.56
1940.....	801,926	175,663,792	1,293,131,693	1,716	82,861	1.33	64.08
1941.....	835,095	195,425,228	1,440,988,174	1,621	90,319	1.12	62.68
1942.....	802,640	1208,739,906	1,542,630,562	1,862	194,465	1.21	61.24
1943.....	763,320	212,765,574	1,605,854,848	1,799	89,520	1.12	55.73
1944 ¹	693,800	197,713,000	1,570,600,000	1,563	86,391	1.00	55.01

¹ Revised figure.

² Subject to revision.

The foregoing employment data point out the difficulties in meeting production requirements in many mineral industries and indicate some of the accumulated strains of 3 years of war on the employees who, during the past several years, have worked longer days and more days each year.

Despite these and other handicaps brought on by the war, the over-all safety record of the mineral industries for 1944, as measured by injury-frequency rates, was the best ever attained in any year since the start of complete injury statistics on mining and quarrying in 1930. The estimate of 1,563 fatalities among workers in the mineral industries in 1944 was lower than in any year since 1939 and was at a rate of 1.00 per million man-hours of exposure to hazards. The number of nonfatal injuries that disabled employees for longer than the day on which the accident occurred was estimated to be 86,391 for the year. This total was the lowest of any year since 1940 and was at a rate of 55.01 per million man-hours worked, a slight decline from the corresponding nonfatal rate of 55.73 in 1943. This record is most commendable when it is considered that such wartime handicaps as loss of skilled employees to the armed forces, relatively high rates of labor turn-over, the longer workday, maintenance of a high level of output with reduced personnel, and the difficulties in securing repair parts and replacements for badly worn machinery were surmounted successfully.

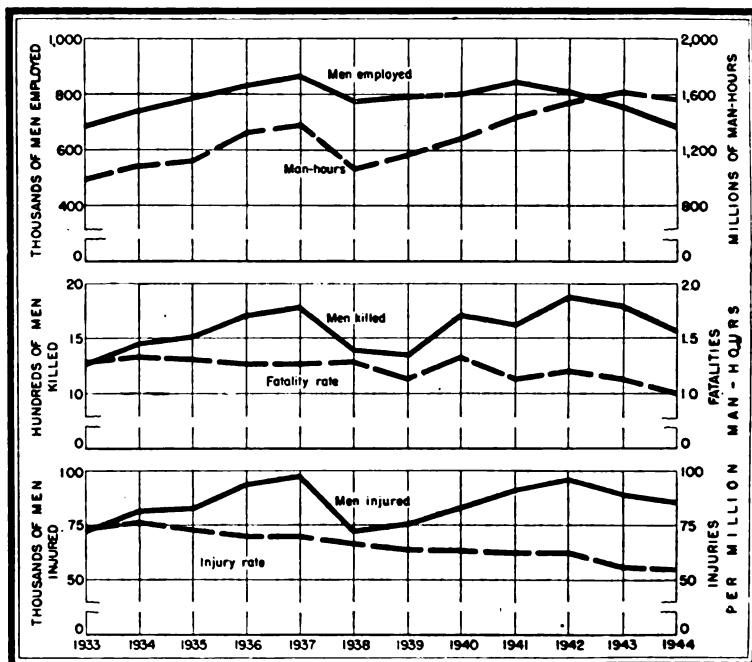


FIGURE 1.—Trends of employment and fatal and nonfatal injuries in the mineral industries of the United States, 1933-44.

The safety record in the coal-mining industry had the greatest improvement of any of the mineral industry groups in 1944 over 1943. The frequencies per million man-hours of work in coal mining during 1944 were estimated at 1.29 on fatal and 65.83 on nonfatal injuries compared with corresponding final rates of 1.56 and 69.55 in 1943. In the metal- and nonmetal-mining industries, the injury records also were more favorable than in 1943. These industries had the following preliminary rates per million man-hours of exposure in 1944: Metal mining, 0.80 on fatalities and 54.89 on nonfatalities; and nonmetal mining, 0.60 for fatalities and 51.77 for nonfatalities. The quarry, coke, and metallurgical plants had poorer safety records in 1944 than in 1943, and the estimated injury-frequency rates in these industries advanced to 0.58 for fatalities and 34.43 for nonfatalities in quarrying, to 0.21 for fatal and 26.43 for nonfatal injuries in metallurgical plants, and to 0.19 for fatalities and 14.43 for nonfatalities in coke plants.

EMPLOYMENT AND ACCIDENTS

BITUMINOUS-COAL MINES

Employment.—The principal drain on the labor supply of bituminous-coal mines in 1944 was the drafting of men into the armed forces. Other contributing elements were the attraction of employees from coal mining to less-arduous or higher-paying industries, the retirement of elderly miners, and the loss of manpower through accidents. The combination of these factors in the tight wartime labor market that prevailed through 1944 resulted in a reduction of workers in bituminous-coal mines to 380,000 men from 407,135 men in 1943. The shortage of labor was acute in all except a few scattered localities of the coal-producing areas of the country.

Despite the sharp drop in labor force, production of bituminous coal in 1944 was estimated to have advanced to the record annual total of 620,000,000 short tons. This output was attained with the available supply of labor by working more days, working more hours per day, and more intensive development of stripping operations, which have a high productivity per man employed. As a result of the first two means, the average employee in 1944 worked 8.00 hours on each of the 276 days that the mines were operated compared with 7.28 hours per day and 263 days active in 1943. Total hours of work per year by the average employee advanced markedly to 2,208 in 1944 from 1,911 man-hours in 1943. The mines were operated an estimated total of 839,000,000 man-hours in 1944, a gain of 8 percent over 1943. These data on man-hours of work exclude the "travel time" of underground employees and represent time spent at the place of work. Results of a statistical study¹ under direction of the President's Committee on Portal to Portal Travel Time revealed that a weighted average of 55.88 minutes was required each day by underground employees in bituminous-coal mines to travel from the mine portal to the working place and return to the portal.

Accidents.—The safety record in bituminous-coal mining improved in 1944, and the injury-frequency rates were lower than in 1943. An estimated total of 1,120 men was killed in accidents at the mines in

¹ Letter report to the President of the United States from President's Committee on Portal to Portal Travel Time, May 24, 1944, 2 pp., 6 tables.

1944 at a frequency of 1.33 per million man-hours of work compared with 1.58 in 1943. Nonfatal injuries were estimated to have caused 52,900 men to lose time from work in 1944. These nonfatal injuries occurred at a rate of 62.05 per million man-hours, which was a moderate reduction from the corresponding rate of 65.64 in 1943.

During 1944, there were 4 major disasters in which 94 men lost their lives—22 in explosions of gas or dust and 72 in mine fires. During 1943, there were 7 major disasters in which 161 men lost their lives—148 in explosions of gas or dust and 13 in a mine fire.

Of the 1,120 men killed at bituminous-coal mines in 1944, approximately 92 percent occurred in underground workings, 3 percent in stripping operations, and 5 percent in surface work around the mines. Slightly more than half of the fatalities occurring underground resulted from falls of roof or face, about 20 percent were haulage accidents, 4 percent were caused by machinery, and 3 percent by electricity; the remainder resulted from various other causes. Detailed information on causes of the nonfatal injuries in 1944 are not available, but experience in recent years indicates the following probable cause-distribution in order of frequency of occurrence: Falls of roof or face, haulage, handling materials, hand tools, and machinery.

ANTHRACITE MINES

Employment.—Manpower was scarce in the anthracite-producing regions of Pennsylvania throughout 1944 for reasons similar to those affecting bituminous-coal mines. Although demand exceeded production and allocation of available supplies was used to effect equitable distribution, the number of men working in the anthracite industry declined to 77,500 in 1944 from 79,381 in 1943. However, by the expedients of working the available labor force more days during the year and lengthening the shift slightly and also by increasing the production of strip and culm-bank coal, the total output of prepared anthracite was increased over 1943 to approximately 63,200,000 short tons in 1944. This tonnage excludes "bootleg" coal purchased and prepared by recognized producers, for which no employment data are available. The average employee in 1944 worked 7.17 hours on each of the 292 days the mines were active, compared with 7.05 hours per day for 269 days in 1943. The annual total of hours worked by each employee advanced to 2,090 in 1944 from 1,900 man-hours in 1943. The mines were operated an estimated total of 162,000,000 man-hours in 1944, an increase of slightly more than 11,000,000 hours over 1943. Data on the anthracite industry include underground, strip, surface, culm-bank, breaker, washery, and dredge operations.

Accidents.—An estimated total of 173 fatal injuries occurred in 1944 or 53 less than in 1943. The number of nonfatal injuries likewise was below 1943 and was estimated at 13,000 in 1944. The frequency rates per million man-hours—1.07 for fatalities and 80.25 for non-fatalities—were sharply lower than in 1943. Of the fatal injuries about 88 percent occurred underground, 5 percent in strippings, and 7 percent in surface works.

"Bootleg" operations.—"Bootleg" operations apparently are much more hazardous than the mines of recognized producing companies. Comparison of the accident records of the legitimate industry with data computed from compilations² of the Anthracite Committee

² Anthracite Committee, Seventh Survey of Bootleg Holes: Commonwealth of Pennsylvania. Dept. of Commerce, Mar. 7, 1945, 7 pp.

shows a total of about 365,000 tons of coal mined and prepared for each fatality in legitimate operations, whereas only 61,905 tons were mined in "bootleg" mines for each fatal injury in 1944. According to the committee, there were 61 fatalities in "bootleg" operations in 1941, 45 in 1942, 22 in 1943, and 21 in 1944. Output from "bootleg" mines was estimated at 6,300,000 short tons in 1941, 3,900,000 in 1942, 1,900,000 in 1943, and 1,300,000 in 1944. Men employed in "bootlegging" coal totaled 10,762 in 1941, 4,967 in 1942, 2,752 in 1943, and 2,220 in 1944.

IRON-ORE MINES

Employment.—Employment data on iron-ore underground and open-cut mining declined sharply in 1944. The number of men employed fell 12 percent from 1943 to approximately 26,200 in 1944, and the total time worked decreased 14 percent to about 59,000,000 man-hours in 1944. Employees worked an average of 281 days in 1944 and 290 in 1943.

Accidents.—Injuries occurred at virtually the same frequencies in 1944 as in 1943. Tentative figures indicate that there were 38 fatal and 1,458 nonfatal injuries in 1944 compared with 47 and 1,663 injuries, respectively, in 1943. The frequency rates in 1944 were 0.64 per million man-hours for fatalities and 24.69 for nonfatalities.

COPPER MINES

Employment.—The number of men working at underground and open-pit copper mines declined markedly to an estimated total of 18,500 in 1944 or 22 percent lower than in 1943. Total man-hours of work in the industry fell 23 percent from 1943 to approximately 46,500,000 hours in 1944. The mines were operated 309 days or 11 days less than in 1943.

Accidents.—The 1944 accident record improved moderately over 1943. Preliminary estimates indicate that 38 men were killed and 2,536 injured nonfatally during the year. Fatal injuries in 1944 occurred at a rate of 0.82 and nonfatalities at 54.46 per million man-hours. The corresponding rates were 1.15 and 57.77 in 1943.

LEAD-ZINC MINES (MISSISSIPPI VALLEY STATES)

This classification includes lead-zinc mining operations in Arkansas, Oklahoma, Missouri, Kansas, Tennessee, Illinois, and Wisconsin. In prior years, fluorspar mines in Kentucky and Illinois were included also, but they have been transferred to the nonmetal-mine group. The data for 1943 and 1942 have been revised to be comparable with 1944.

Employment.—The number of men working in this group of lead-zinc mines fell 21 percent below 1943 to a preliminary total of 7,300. The total volume of employment, measured in man-hours, declined to slightly more than 16,000,000 hours, or 19 percent lower than in 1943. However, employees worked an average of 280 days compared with 275 in 1943.

Accidents.—Accidents at these operations in 1944 resulted in 15 deaths and 1,311 disabling injuries. The fatality rate of 0.92 per million man-hours of exposure in 1944 was slightly more favorable

than in 1943 but was higher than the 0.56 rate for 1942. The frequency of nonfatal injuries was appreciably higher in 1944 and was at a rate of 80.00 compared with 60.71 in 1943 and 48.31 in 1942.

GOLD AND SILVER MINES (LODE AND PLACER)

This group includes not only mines operated principally for gold and silver but also those lead-zinc mines outside the Mississippi Valley States. After the gold mines were closed by the Federal Government as a war measure in 1942, the group in 1943 and 1944 comprised largely the lead-zinc mines in the Eastern and Western States.

Employment.—On a basis of preliminary reports, about 11,400 men worked at lode mines and 800 at placers. Lode mines in 1943 employed 14,885 men and placer mines 1,398. Man-hours of work totaled 26,300,000 at lode mines and 1,100,000 hours at placer. The lode mines were worked 294 days in 1944, an increase of 7 days over 1943, whereas placers were operated only 170 days or 10 less than in 1943.

Accidents.—Accidents at lode mines resulted in 32 fatal and 2,772 nonfatal injuries, at respective frequencies of 1.21 and 105.22 per million man-hours of exposure. The nonfatal injury rate was slightly improved over 1943, but the fatality rate was poorer. There were no fatal injuries at placer operations in either 1943 or 1944. However, the frequency of nonfatalities advanced from 32.67 in 1943 to 37.82 per million man-hours in 1944.

MISCELLANEOUS METAL MINES

Mines producing antimony, bauxite, chromite, cobalt, manganese, manganiferous iron, mercury, molybdenum, pyrite, titanium, tungsten, and vanadium-uranium are included in this group.

Employment.—Employment at operations in this classification receded sharply from 9,229 workers in 1943 to an estimated total of 5,000 men in 1944. Man-hours of work fell to approximately 10,500,000 in 1944 from nearly 21,000,000 in 1943. Similarly, the mines were operated only 262 days or 21 days less than in 1943.

Accidents.—The safety record in the miscellaneous metal mines was more favorable than in 1943. There were 5 fatal and 664 nonfatal injuries at respective rates of 0.47 and 62.88 per million man-hours of work in 1944. The corresponding rates in 1943 were 0.95 for fatalities and 68.61 for nonfatalities.

NONMETAL MINES

This group includes operations producing barite, feldspar, fluorspar, gypsum, magnesite, mica, phosphate rock, rock salt, sulfur, and other miscellaneous nonmetallic minerals. It does not include operations producing limestone, granite or other stone, sand, gravel or clay. Fluorspar mines in Kentucky and Illinois are included in this report under this classification for the first time by transferring them from Lead-zinc (Mississippi Valley States). The 1942 and 1943 data have been revised to be comparable with 1944.

Employment.—An estimated total of 11,900 men was working in the mines of this group during 1944—a decline of approximately 800

men from 1943. The aggregate man-hours worked by these men fell to approximately 26,500,000 hours in 1944 from nearly 28,000,000 in 1943. The average mine in the group was operated 255 days during the year.

Accidents.—The injury record in nonmetal mines improved over 1943. The estimated total of 16 fatal injuries was at a rate of 0.60 and the 1,372 nonfatal injuries at 51.77 per million man-hours of exposure. The corresponding rates for 1943 were 0.89 for fatalities and 52.57 for nonfatalities.

CEMENT MILLS AND QUARRIES

Employment.—Reports indicate that 20,600 men were working in cement mills and quarries, a 20-percent decrease from the 25,811 men in 1943. Man-hours of employment fell 25 percent to a total of 44,800,000 hours in 1944. The continued decline in demand for cement resulted in the plants working an average of 273 days in 1944 or 26 days less than in 1943.

Accidents.—The safety record at cement plants was not as favorable as in 1943, and the rate of fatal injuries increased slightly to 0.40 and of nonfatal injuries to 14.73 per million man-hours of exposure in 1944. There were 18 fatalities and 660 nonfatalities at cement mills and quarries in 1944.

MARBLE QUARRIES

Employment.—The decline in employment at marble quarries, which started in 1942, continued throughout 1944. Approximately 1,400 men worked 3,200,000 man-hours in 1944 compared with 1,540 men and nearly 3,700,000 hours in 1943. The quarries were active an average of 264 days in 1944.

Accidents.—The one fatal injury in 1944 was at a rate of 0.31 per million man-hours. There were 98 nonfatalities; these had a frequency of 30.63 per million man-hours of work, more favorable than the corresponding rate of 37.04 in 1943.

SLATE QUARRIES

Employment.—Although there was a slight improvement in demand, the number of workers in slate quarries decreased to 1,200 in 1944. Man-hours of employment showed little change from 1943 and totaled 2,600,000. The quarries were operated 259 days in 1944 or 10 more days than in 1943.

Accidents.—There were 3 fatal and 153 nonfatal injuries in 1944, at respective frequencies of 1.15 and 58.85 per million man-hours. These rates were markedly higher than in 1943, when there were no fatalities and the nonfatality rate was 50.07.

TRAP-ROCK QUARRIES

Employment.—The estimated 2,000 employees at trap-rock quarries worked a total of 4,100,000 hours in 1944 or moderately less than the 2,256 men working approximately 4,300,000 hours in 1943. Days of operation of the quarries increased to 241 in 1944—18 days more than in 1943.

Accidents.—A more favorable safety record was attained in 1944 than in 1943; 2 fatalities and 220 nonfatalities occurred, at rates of 0.49 and 53.66 per million man-hours. In 1943, the fatality rate was 0.93 and the nonfatality rate 58.98.

GRANITE QUARRIES

Employment.—Available reports indicate that 4,100 men worked about 9,000,000 man-hours in granite quarries during 1944. This was a decrease in both the number of men employed and man-hours worked when compared with 1943. The quarries were operated an average of 259 days in 1944 or 16 days more than in 1943.

Accidents.—Both the fatality and nonfatality rates were higher in 1944. The 6 fatal and 417 nonfatal injuries were at respective frequencies of 0.66 and 45.93 per million man-hours in 1944. The corresponding rates in 1943 were 0.52 and 41.94.

SANDSTONE QUARRIES

Employment.—The approximately 2,100 workers at sandstone quarries in 1944 were 14 percent fewer than in 1943. These men worked a total of 4,300,000 man-hours, which was 12 percent below 1943. Days of operation of the quarries increased 8 over 1943 to a total of 250 days in 1944.

Accidents.—Two fatalities and 238 nonfatalities during 1944 represented rates of 0.47 and 55.35 per million man-hours of exposure. These rates were an improvement over the fatal injury rate of 0.82 and the nonfatal injury rate of 56.82 during 1943.

LIMESTONE QUARRIES

Employment.—The number of men employed in limestone quarries declined 12 percent from 1943 to a total of 19,100 men in 1944. Approximately 39,200,000 man-hours were worked or a 13-percent drop from 1943. The number of operating days decreased 1 to a total of 241 days in 1944.

Accidents.—The estimated 27 fatalities and 1,600 nonfatalities in limestone quarries in 1944 represented frequencies of 0.69 and 40.82 per million man-hours of work. The rate of fatal injuries was unchanged, but for nonfatal injuries the rate was improved over the 42.96 frequency in 1943.

LIME PLANTS AND QUARRIES

Employment.—Available reports indicate that the 9,000 men employed in lime plants and quarries worked 23,000,000 man-hours in 1944. This represented declines of 12 percent in men and 10 percent in man-hours from 1943. Lime plants were operated the same number of days in 1944 as in 1943.

Accidents.—There were 16 fatal and 1,100 nonfatal injuries at lime plants in 1944 compared with 15 and 1,284 injuries, respectively, in 1943. The fatality rate advanced to 0.70 per million man-hours, and the nonfatality rate improved from 50.33 in 1943 to 47.83 in 1944.

BYPRODUCT-COKE OVENS

Employment.—Final employment data at byproduct-coke ovens show a total of 21,586 men working in 1944 or only slightly under 1943. Man-hours of employment increased slightly to 62,800,000 compared with 62,600,000 hours in 1943. The gain in man-hours was attained by lengthening the work-shift to 8.02 hours in 1944 from 7.98 in 1943. The coking plants were operated 363 days in both 1943 and 1944.

Accidents.—Accidents at byproduct ovens caused 12 fatalities and 752 nonfatalities which were at corresponding frequencies of 0.19 and 11.97 per million man-hours of exposure. This fatality rate was more favorable than the 0.24 frequency noted for 1943. The nonfatality rate in 1944, however, was less favorable than the 9.75 rate in 1943.

BEEHIVE-COKE OVENS

Employment.—As demand for beehive coke slumped, employment declined rapidly to an average of 3,100 men in 1944, a 25-percent decrease from 1943. These men worked an average of 260 days in 1944, compared with 265 days in 1943. Man-hours of employment totaled 6,400,000 in 1944 or 20 percent below 1943.

Accidents.—The injury record at beehive ovens improved in 1944. One fatality and 247 nonfatalities occurred during the year at frequencies of 0.16 and 38.59 per million man-hours, respectively. In 1943, the corresponding frequency rates were 0.25 for fatal and 46.72 for nonfatal injuries.

ORE-DRESSING PLANTS AND AUXILIARY WORKS

Plants or mills in this group are those in which ores of all metals are processed or treated. The types of operations included are crushing, grinding, washing, concentrating, sintering, cyaniding, leaching, Bayer process, and other methods by which ores of metals are treated. Auxiliary works associated with these mills are principally machine shops, yards, and general construction work.

Employment.—The number of men employed in 1944 ore-dressing plants totaled 23,400 of which 14,700 men worked in direct milling of ore and 8,700 men were employed on the auxiliary works. The total employment was off slightly from 1943. The volume of employment measured in man-hours also declined slightly from 1943 to a total of slightly more than 59,000,000 hours. Man-hours worked declined from 1943 in mill operations but increased at the auxiliary works. Copper, miscellaneous metal, lead-zinc, iron, and gold-silver mills ranked in that order in number of workers and man-hours of work performed in 1944.

Employment and accident data at mills and auxiliary works in the United States, 1942-44, by metals

Metal and year	Average number of men working			Man-hours worked, in thousands			Accident-frequency rate per million man-hours		
	Mill ¹	Auxiliary ²	Total	Mill ¹	Auxiliary ²	Total	Mill ¹	Auxiliary ²	Total
Copper:									
1942.....	4,556	2,220	6,776	12,914	6,911	19,825	18.81	31.13	22.00
1943.....	4,409	2,686	7,095	12,370	7,427	19,797	19.48	25.66	21.57
1944 (estimate).....	4,100	3,500	7,600	11,350	9,403	20,753	24.86	21.06	23.08
Iron:									
1942.....	2,519	700	3,219	2,259	1,743	4,002	9.70	16.63	20.00
1943.....	2,706	502	3,208	5,538	1,300	6,838	14.26	13.08	14.04
1944 (estimate).....	2,600	700	3,300	5,084	1,696	6,780	13.71	11.79	13.22
Gold-silver:									
1942.....	2,334	373	2,707	5,010	816	5,826	55.29	41.67	53.38
1943.....	773	194	967	1,834	478	2,312	56.28	8.58	62.26
1944 (estimate).....	400	500	900	939	990	1,929	48.96	41.42	45.10
Lead-zinc (United States):									
1942.....	2,329	1,380	3,709	5,657	3,516	9,173	26.17	21.04	24.20
1943.....	3,106	1,742	4,848	7,322	4,248	11,570	32.92	21.19	28.61
1944 (estimate).....	2,800	1,800	4,600	6,819	4,312	11,131	39.60	19.94	31.98
Miscellaneous metals: ³									
1942.....	1,955	983	2,938	4,525	2,459	6,984	41.99	30.50	37.94
1943.....	5,674	2,475	8,149	15,527	6,777	22,304	29.43	29.96	29.59
1944 (estimate).....	4,100	2,200	6,300	9,969	6,682	16,651	31.30	25.29	28.89
Total:									
1942.....	13,693	5,656	19,349	33,365	14,734	48,099	27.24	27.49	27.32
1943.....	16,668	7,599	24,267	42,329	20,229	62,558	26.44	26.55	26.47
1944 (estimate).....	14,700	8,700	23,400	36,750	22,528	59,278	29.66	20.56	26.20

¹ Includes crushers, grinders, washers, ore-concentration, sintering, cyaniding, leaching, Bayer, and all other metallic ore-dressing plants.

² Includes maintenance and repair shops, yards, general construction, and other associated works.

³ Includes antimony, bauxite, alumina, mercury, manganese, tungsten, chromite, vanadium, molybdenum, titanium, and other metals. Mills producing alumina included in 1943-44 but not in 1942.

Accidents.—The combined fatal and nonfatal injury rate of 26.20 per million man-hours at mills and associated works was virtually unchanged from 1943. However, injuries in mills occurred more frequently in 1944, whereas the frequency of injuries in the auxiliary works was more favorable than in 1943. Iron mills and auxiliaries had the best safety record in 1944 of the various groups of plants arranged according to ores processed.

SMELTERS, REFINERIES, REDUCTION PLANTS, AND AUXILIARY WORKS

Plants in this group are engaged in the primary extraction of non-ferrous metals from ores and include, among others, smelters, refineries, and reduction, roasting, electrolytic, and retort plants. Auxiliary works are the associated machine shops, yards, general construction, and other shops. Iron and steel plants are excluded.

Employment.—Employment at these extractive plants declined approximately 8,500 men from 1943 to a total of 47,600 men in 1944. Man-hours of work performed in 1944 were well below 1943 and totaled 124,300,000 hours. The declines in men and man-hours were sharp in the direct process of extraction and also in the auxiliary

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works. The plants processing miscellaneous metals had the largest employment of the several plant groups in 1943 and 1944 owing to the great expansion in plants producing aluminum and magnesium metals.

Employment and accident data at primary smelters, refineries, reduction plants, and auxiliary works in the United States, 1942-44, by metals

Metal and year	Average number of men working			Man-hours worked, in thousands			Accident-frequency rate per million man-hours		
	Smelt-er ¹	Auxil-iary ²	Total	Smelt-er ¹	Auxil-iary ²	Total	Smelt-er ¹	Auxil-iary ²	Total
Copper:									
1942	10,286	5,730	16,016	27,911	15,451	43,362	17.70	17.02	17.46
1943	10,153	5,731	15,884	28,533	16,012	44,545	20.01	14.61	18.07
1944 (estimate)	8,200	4,300	12,500	23,099	12,489	35,588	24.38	11.53	19.87
Lead, Silver-lead:									
1942	2,377	1,607	3,884	6,526	3,728	10,254	22.52	12.88	19.02
1943	2,226	1,363	3,589	5,856	3,560	9,416	25.62	17.14	22.41
1944 (estimate)	2,300	1,300	3,600	6,182	3,295	9,477	25.40	15.48	21.95
Zinc:									
1942	6,350	3,620	9,970	17,950	10,306	28,256	43.84	30.08	38.82
1943	6,869	3,997	10,866	19,429	11,339	30,768	38.29	22.75	32.57
1944 (estimate)	6,400	3,400	9,800	18,114	9,589	27,703	36.43	24.61	32.34
Miscellaneous metals: ³									
1942	1,623	312	1,935	4,229	800	5,029	72.60	41.26	67.61
1943	18,012	7,792	25,804	48,305	20,898	69,203	33.00	22.92	29.96
1944 (estimate)	19,100	4,900	24,000	44,810	10,895	55,705	22.14	22.12	22.13
Total:									
1942	20,636	11,169	31,805	56,615	30,284	86,899	30.64	21.60	27.49
1943	37,260	18,883	56,143	102,123	51,809	153,932	29.95	19.92	26.58
1944 (estimate)	32,900	14,700	47,600	85,782	38,521	124,303	30.26	19.24	26.85

¹ Includes smelters, refineries, reduction, roasting, electrolytic, retort and all other plants producing non-ferrous metals.

² Includes maintenance and repair shops, yards, general construction, and other associated works.

³ 1942: Includes mercury, antimony, and tin plants; 1943-44: Includes mercury, antimony, tin, magnesium, and aluminum plants.

Accidents.—The combined frequency rate of 26.85 per million man-hours for fatal and nonfatal injuries was relatively unchanged in 1944 from 1943. Injuries to workers in the extractive processes occurred slightly more frequently in 1944, whereas injuries to employees in the associated works were slightly less frequent than in 1943. Workers in copper plants had the best over-all safety record of the several classes of plants in this group in 1944.

PART V. FOREIGN MINERALS

FOREIGN MINERALS REVIEW

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GENERAL SUMMARY

By J. S. McGRATH

Nothing in history has demonstrated as emphatically as World War II the vital value of predominant access to the world's resources of strategic mineral raw materials, and maintenance of control in the hands of the United Nations has been inevitable to the final outcome. During the course of the struggle all former production records have been surpassed. Most items are believed to have reached their peak years in 1942 and 1943, with relaxation in military requirements reflected in the outset of a decline in 1944. Outstanding exceptions are petroleum, the fuel of war, which established an all-time production record in 1944, and the precious metals, which are not essentially strategic and have been declining steadily since 1940. Transportation facilities and shortages have affected fluctuations in output and emphasized again the fact that no nation is completely self-sufficient in resources required either to wage war successfully or to conduct a balanced peacetime economy.

The Allied victory in Europe, in sight at the close of 1944, had been preceded by a year during which extensive wartime discussions of world security were held. These eventually crystallized into a United Nations Charter approved in June 1945 by representatives of 50 countries. Between August 21 and October 7, 1944, representatives of Great Britain, United States, U. S. S. R., and China met at Dumbarton Oaks, Washington, D. C., to discuss the establishment of a world organization to maintain peace and security. Tentative and incomplete proposals were prepared and submitted for study to the Governments concerned, and these proposals ultimately served as a basis of discussion by the complete United Nations Conference that convened in San Francisco on April 25, 1945.

The Atlantic Charter, a joint declaration (now regarded as somewhat nebulous) by the Prime Minister of Great Britain and the President of the United States on August 14, 1941, provided for access of all nations on equal terms to the trade and to the raw materials of the world needed for their economic prosperity. The Charter of the United Nations, approved by the San Francisco Conference on June 25, 1945, has as its over-all purpose the maintenance of international peace and security, and to that end one of its four provisions is "to achieve international cooperation in solving international problems of an economic, social, cultural, or humanitarian character * * *"

It was evident toward the end of 1944 that, in those countries of the world where the internal economy is supported chiefly by the mining industries and where export markets for mineral commodities for generations have represented the principal sources of revenue, potential burdensome surpluses and widespread distress were problems of almost immediate concern to the Governments involved. It likewise was apparent early in 1945 that "international cooperation in solving international problems of an economic, * * * character * * *" would be the only means of coping with the serious aftermath of the wartime mineral development and procurement program. These problems pertain especially to the Western Hemisphere, where the United States during the war period consumed on an unprecedented scale practically all minerals available throughout Latin America, in most countries of which annual rates of production surpassed all prior levels.

Insofar as data are available, this chapter briefly records the highlights of the mineral production and trade of foreign countries in 1944 and earlier war years.

BRITISH DOMINIONS OF NORTH AMERICA

By FRANK L. FISHER

CANADA

Canadian mineral production was valued at \$485,924,000¹ in 1944 compared with \$530,054,000 in 1943. Metal production decreased

¹ All references to dollars are in terms of Canadian dollars. The official buying rate for drafts on New York is 1 Canadian dollar equals 0.90909 United States dollar.

14 percent in value. The total value of fuels, which includes coal, natural gas, crude petroleum, and peat, increased 7 percent mainly by an allowable increase in the producer's price of coal. Production of industrial minerals and structural materials showed little over-all change from the value for the previous year. Ontario contributed 43 percent of the value of mineral production, and Quebec and British Columbia were next in order of importance. Nova Scotia had the only marked increase in value of mineral production over 1943. The general decrease was due primarily to an acute labor shortage that prevailed in 1944, to restrictions on gold production, and to a smaller extent to easing of the demand for some strategic minerals.

Gold production decreased 21 percent in value. Platinum and allied metals also decreased sharply from the previous year. The other minerals that showed marked declines in production from 1943 were copper, zinc, lead, silver, iron ore, cadmium, chromite, mercury, selenium, salt, tin, arsenic, bismuth, and cobalt. There was little over-all change from 1943 in the production of nickel, asbestos, coal, petroleum, gypsum, magnesite, peat moss, quartz, sodium sulfate, sulfur, clay products, cement, lime, stone, sand, and gravel. The production of pig iron, steel ingots and castings, magnesium, molybdenite concentrate, barite, mica, antimony, and tellurium increased for 1944.

Shipments of iron ore from Steep Rock Iron Mines, Ltd., were begun during the year. The discovery of several extensive iron-ore deposits was reported—in Labrador on the upper basins of the Hamilton and Naskaupi Rivers and in Quebec on the headwaters of the George, Whale, and Swampy Bay Rivers.

Gold.—Gold continued to be the most important mine product of Canada in value. Production dropped 21 percent below the preceding year to the lowest since 1931. The 1944 output was 2,885,474 fine ounces. Ontario mines contributed 1,704,457 ounces or 59 percent of the total. Quebec produced 740,744 ounces to continue as the second-largest producer, and British Columbia produced 191,423 ounces for the year. The number of operating mines decreased from the previous year, but considerable prospecting, particularly in the Yellowknife district, was evidenced and indicated quick resumption of gold-mining activity in the immediate postwar period.

Copper.—Output in 1944 amounted to 547,943,586 pounds. The principal sources of the copper were Noranda, Normetal, and Waite Amulet mines in Quebec; the nickel-copper mines of Ontario; the Flin Flon on the Manitoba-Saskatchewan boundary; the Sherritt-Gordon in Manitoba; and the Britannia and Granby mines in British Columbia. The refined-copper production by the two Canadian refineries was 505,741,000 pounds for the year.

Lead.—Lead production was 301,073,919 pounds in 1944. The Sullivan mine of the Consolidated Mining & Smelting Co., Ltd., was the largest producer. Lead concentrates were also produced in Quebec, Ontario, and Yukon Territory.

Nickel.—Nickel production for the year totaled 275,213,106 pounds, and all came from the Sudbury area; the International Nickel Co. furnished 93 percent, Falconbridge Mines 6.2 percent, and others 0.8 percent. A marked decrease in the production of platinum and its associated metals was noted.

Silver.—The output of silver continued to decline, with 13,586,502 fine ounces produced during the year, entirely from the treatment of ores of other minerals. The Sullivan mine at Kimberley, British Columbia, was the largest producer.

Zinc.—Zinc production amounted to 561,072,538 pounds for the year. The Sullivan mine at Kimberley, British Columbia, was the principal source. The Flin Flon mine of the Hudson Bay Mining & Smelting Co. was another important producer.

Other metals.—The production of several strategic metals was stimulated by war demands during the year. A well-established magnesium industry was developed. Tin was produced from the tailings of the Sullivan mill at Kimberley, British Columbia. Chromite, tungsten, molybdenite, and mercury were produced during the year, but the easing of demands for these metals retarded development before the end of the year, and in some instances production actually ceased.

The production of the following metals was also reported for the year: Antimony, arsenic, bismuth, cobalt, iron ore, manganese, selenium, tellurium, and titanium. Information on the production of pitchblende products was not available.

Asbestos.—Canada continued to be the world's greatest producer of asbestos. The mines, situated in the Eastern Townships of Quebec, produced 419,265 short tons during the year. The bulk of it was exported unmanufactured to the United States.

Feldspar.—The production of feldspar totaled 20,494 tons and came from the Provinces of Ontario and Quebec.

Other nonmetallic minerals.—Production of corundum, graphite, and mica were reported during the year and resulted from the war demands for strategic materials. The corundum production was from reworked tailings. Graphite production amounted to 1,565 tons, all of it coming from the Black Donald mine in Renfrew County, Ontario. Mica production was 6,087,627 pounds. Much of the mica comes from the Eau Claire area near Mattawa, Ontario, where the crystals are phenomenally large, some measuring 5 by 8 feet across. The production of the following industrial minerals was also reported for the year: Barite, clay, cement, fluorspar, gypsum, iron oxides, lime, magnesitic dolomite, brucite, nepheline syenite, peat moss, phosphate, pyrites (sulfur), quartz, salt, sodium carbonate, sodium sulfate, talc, and soapstone.

Coal.—Coal production totaled 17,010,117 short tons for 1944, a decrease from the previous year. Alberta was the leading producer, followed by Nova Scotia, British Columbia, Saskatchewan, and New Brunswick.

Natural gas.—Production of natural gas was 45,956,800 M cubic feet for the year. Alberta is the leading producer, with the Turner Valley field contributing the bulk of the production. Ontario, New Brunswick, and Saskatchewan also reported production.

Petroleum.—Total petroleum production for the Dominion in 1944 was 10,071,100 barrels. The Province of Alberta continued to provide the bulk of the Canadian output, and additional production was reported from Northwest Territories, Ontario, and New Brunswick. There was a record amount of exploration and drilling in Alberta and Saskatchewan during the year in search of new fields. No discoveries were made in Saskatchewan, but in Alberta several new producing

areas were reported. The Canol pipe line operated throughout the year and, at the end of 1944, 58 wells in the Norman Wells field were capable of producing oil.

NEWFOUNDLAND

The mining industries of Newfoundland operated on a stable basis in 1944. The Wabana iron mines produced 517,530 short tons of iron ore, a slight decrease from 1943, and the Indian Head mines reported production of magnetite. The Buchans mine operated at capacity throughout the year with a production of 405,500 short tons of crude copper-lead-zinc ore. Two companies produced 65,254 short tons of fluorspar. No talc was produced during the year, but shipments were made from stock. Prospecting and geological studies continued; specific interest was shown in coal, molybdenum, gold, asbestos, and copper. The exports of mineral products for the fiscal year 1944 totaled \$9,029,416—an increase of \$1,847,601 over the previous fiscal year.

MIDDLE AMERICA ²

By SUMNER M. ANDERSON ³

BRITISH WEST INDIES

Barbados.—In addition to minor quantities of limestone, sandstone, and salt, Barbados produces and refines crude petroleum from shallow wells for domestic use. Production, never important, has declined during the war years to less than a thousand barrels in 1944 and is insufficient to meet local requirements. Less than a hundred tons of natural asphalt is also produced annually for export.

Jamaica.—Limestone quarrying and irregular recovery of salt from sea water constitute the only mineral industries of Jamaica. In 1942 and 1943 large, low-grade bauxite deposits estimated at 100,000,000 tons, were discovered in both the northern and southern parts of the island. Early in 1944, after examination by three companies, the Jamaica Bauxite, Ltd., was formed as a fully owned subsidiary of the Aluminum Co. of Canada, Ltd., but development of the deposits has not yet been initiated.

Trinidad.—The famous asphalt lake continues to maintain Trinidad in top position among the natural asphalt producers of the world, even though production has declined steadily since the peak year 1927. Production figures have not been revealed since 1941 when output was 81,753 metric tons.

Petroleum production probably reached about 25 million barrels in 1944, but official figures are not available. About eight large and half a dozen or more small companies send crude petroleum to four principal refineries and in export to England, the United States, and Canada. All refinery production, exclusive of moderate amounts required for domestic use, are exported, normally to widely scattered

² Anderson, S. M., Minerals Review of Latin America, 1939-44. Bureau of Mines Foreign Minerals Survey, vol. 2, No. 4, 1945 (see for more detailed review).

³ Export sections by A. Taeves

destinations. Quantities and distribution of exports in recent years have not been officially revealed.

Trinidad also has a small quarrying industry of local importance only.

Other islands.—Mineral industry elsewhere in the British West Indies is confined to unimportant production of salt, lime, and phosphate rock.

CUBA¹

Chromite.—The mining of refractory-grade chromite in Cuba in 1944 was restricted to 50 percent of 1943 production because of the large stock piles accumulated in the Island, from which withdrawals for shipment advanced exports to the United States to a position 6 percent higher than in the preceding year and 72 percent greater than production. Reduction of output actually dates from October 1943, when purchases were suspended by the Metals Reserve Company and resumed by private industry. The Cayoguan mine near Punta Gorda supplied considerably more than half of the 173,220 metric tons of ore mined in 1944, and the remainder came from mines of the Juragua Iron Co. and E. J. Lavina & Co. in the Camaguey district. Reserves in the Punta Gorda and Camaguey areas are such as to insure production adequate to meet export demand in 1945, which may equal or even exceed that of 1944.

Production of lump metallurgical-grade chromite responded to increased demand with increased output of Bethlehem Steel's Caledonia mine in the Mayarí district, augmented slightly by about 2,300 tons from small lenses exploited by Cia. Miranda-Gasset in the Sagua de Tanamo district. Although total chromite production decreased in 1944, that of the metallurgical grade advanced more than 150 percent over the 1943 tonnage to 18,911 metric tons. Development of new deposits in the Mayarí district, however, are not considered to be economically justified at present world prices.

Copper.—Copper-ore production in 1944 advanced slightly over 1943 to 6,584 metric tons of contained metal, but the general trend for several years has been downward, reflecting the depletion of ore reserves at Cuba's only important copper mine at Matahambre in the Province of Pinar del Rio. Early in 1944 new, important reserves were developed, and downward trend of production is expected to show an upward turn in 1945. Of the total 1944 output, about 80 tons of copper-in-ore was supplied by 14 small mines in the Provinces of Oriente and Pinar del Rio, under the stimulus of a purchasing agreement with the United States Commercial Company that functioned from March 1943 through September 1944.

Precious metals.—Mining of gold and silver ores has not been reported since 1941. Production today is entirely incidental to the mining of other ores, mainly copper, with which the precious metals are associated in negligible quantities.

Iron.—The Mayarí mines suspended operations in 1943 and 1944, and ore production dropped to the level of output of magnetite and hematite, all of which is being stock-piled, by the only remaining mine of the same company at Firmeza. Production amounted to only 28,370 metric tons in 1944, and the outlook for 1945 is not encouraging.

¹ Review prepared from data supplied by C. A. Botsford, U. S. minerals attaché, Habana.

Manganese.—At the close of 1944 the manganese procurement program of the United States Commercial Company was restricted to the purchase of ores containing 47 percent or more manganese. This curtailment was partly offset by purchases of private buyers who entered the field and contracted for the output of two of the most important mines producing ores averaging 45 percent manganese. However, production dropped from 311,214 metric tons in 1943 to 257,864 tons in 1944. Cuban manganese deposits occupy a broad zone in the Sierra Maestra in Oriente Province, and ore is mined by about 70 small operators.

Nickel.—Production of nickel oxide at the plant of the Nicaro Nickel Co. at Nicaro, Oriente Province, started in December 1943 and increased continuously throughout 1944 to a total output of 6,260 metric tons in that year, derived from 587,573 tons of ore. Full-scale operation is expected to be attained by the middle of 1945, when the production rate should become stabilized. Mechanical and metallurgical problems have been successfully solved for the recovery of nickel oxide from ore by an ammonia-lixiviation process. It was originally planned that the oxide would be reduced to metallic nickel by electric smelting in Wilmington, Del., but recent tests at the steel furnaces have shown that intermediate smelting is unnecessary, and the oxide is now introduced direct into the steel furnaces.

Barite.—Beginning in 1936, exports of Cuban barite rose to a peak of 16,223 tons in 1941 and dropped to 3,158 tons in 1943. Quarrying for the Mineral Products Corporation's grinding plant at Regla, Habana, was suspended in 1942. In 1944, because of short supply in the United States, the United States Commercial Company contracted for 10,000 short tons (907 metric tons) of ground barite of specifications customarily used in oil-well drilling, and slightly more than half this amount was shipped during the year from stocks on hand.

Magnesite.—The mining and export of Cuban magnesite extended from 1939 into 1944, when it was suspended because of the development of large scale production in the United States. The peak year was 1941, when production from small pits near Santa Clara amounted to 16,223 tons.

Miscellaneous minerals.—Marble and other building stone, crushed stone, sand, gravel, clay, cement, gypsum, salt, and pigment earths are produced at various localities for local use and to some extent for export. Also in 1944, for the first time, 5 tons of anthophyllite asbestos were mined and exported to the United States for use as filtering fiber.

Natural asphalt.—Asphalt distributed through every Province in Cuba is of three types: Gilsonite, asphaltites averaging about 20 percent ash, and asphaltites averaging about 40 percent ash and 5 to 7 percent sulfur. Gilsonite is chiefly exported, and asphaltite up to 20 percent ash has been in local demand for fuel since restrictions on fuel imports were brought about by war conditions. The greatest concentration of asphaltic resources is in the Provinces of Pinar del Rio and Santa Clara. Production in 1943 and 1944 amounted to 45,000 and 4,000 metric tons, respectively.

Petroleum.—Cuban petroleum migrated from its source beds to accumulate in shattered pockets in serpentine that have been tapped in three developed fields, none of which is of major importance. No commercial production has been found in sedimentary rocks, the usual depository in the world's great oil fields.

The Bucuranao field in the Province of Habana produced heavy-gravity crude petroleum from 1914 to 1943, in which year the field was said to be exhausted. Output had steadily declined to 1,200 barrels in its last year of operation.

The Motembo field in the western part of Las Villas Province produces a clear, colorless naphtha or natural gasoline that is used in automobile engines in its natural state. Discovered in 1881, the field was not developed commercially until 1934. Production has declined steadily from its peak of 160,457 barrels in 1941 to 94,171 barrels in 1944. More than half the holes drilled are dry, and the ratio of dry holes to producing wells is increasing.

The Jarahuca field near the eastern border of the Province of Las Villas was discovered October 16, 1943. The product, a natural-gas oil, is used to some extent for motor fuel without refining. However, about half of that produced is too heavy for such use, and a part is processed at a newly installed skimming plant at the field and a part refined at the small plant of the Union Oil Co. that formerly treated the crude of the Bucuranao field. The entire output of the field, amounting to 14,831 barrels in 1944, finds a ready local market, and the trend of field development is upward.

At present the Standard Oil Co. of Cuba (Standard Oil Co. of New Jersey subsidiary) and the Estrella Co. (Shell and others) are engaged in petroleum exploration in Cuba, using survey parties and test drilling.

Exports.—Cuba's exports of metallic ores and concentrates in 1944, all of which went to the United States, amounted to only 4.2 percent by value of total Cuban exports of all commodities. Exports of nonmetallic minerals and hydrocarbons have not been completely reported but are known to be of small consequence in comparison with metallic ores and concentrates, which were valued at about \$US18,108,000.

Foreign trade in diamonds has not been mentioned in the preceding discussion because diamonds are not produced in Cuba, but it is of interest in indicating progress in the cutting industry established during the war by European refugees. In 1944 Cuba imported 201,983 carats of rough diamonds from the United States valued at \$2,543,000, and in the same year exported to the United States 43,179 carats of cut and polished stones valued at \$6,575,000.

DOMINICAN REPUBLIC

Gold.—Production of placer gold, normally small, has dropped to less than 1,000 ounces in 1943 and 1944.

Bauxite.—Deposits of bauxite estimated at 20,000,000 tons of probable ore have been examined by the Reynolds Metals Co. and the Aluminum Co. of America. Development plans have not been announced, but future commercial importance is a possibility.

Miscellaneous minerals.—Lime, gypsum, and salt are produced in minor amounts. Exploration for petroleum resulted in the production of 6,000 barrels in 1941 but no commercial quantities since.

HAITI

Haiti produces insignificant amounts of placer gold (161 troy ounces in 1944) and about 8,000 metric tons of sea salt annually. Lime and limestone, building and construction stone, and clay are produced in unreported quantities. Potentially important are bauxite deposits discovered in seven localities during and since 1943, of which the Ste. Croix area of the southern peninsula holds the most promise. Surveys of deposits are being conducted by the Reynolds Mining Corp., which was granted a concession in February 1944.

The Atlantic Refining Co. is continuing prospecting and drilling started in 1943 in structures that appear to be favorable to the accumulation of petroleum.

NETHERLANDS WEST INDIES

Aruba and Curaçao.—Though the Netherlands West Indies produce no crude petroleum, the life blood of their economy flows in the great petroleum refining industry that occupies the islands of Aruba and Curaçao. The Aruba refinery of the Lago Oil & Transport Co., a subsidiary of the Standard Oil Co. of New Jersey, is estimated to have produced between 55 and 60 percent of the refined output of the Netherlands West Indies in 1944, with the remaining 40 to 45 percent supplied by the Curaçao refinery of Curaçaosche Petroleum Industrie Maatschappij, owned by the Dutch-Shell Oil Co. Supplies of crude petroleum refined on Aruba and Curaçao represent roughly 60 to 80 percent of Venezuela's total production and 15 to 40 percent of Colombia's total. About 90 percent of the refined products have been distributed to the armed forces of the United Nations in the various theaters of war and the remainder to European neutrals and Latin American commercial outlets through distributing agencies of the United States Government. Production and export figures have not been released since 1938, but exports are estimated at 134,000 barrels in 1943 and 171,000 barrels in 1944.

Aruba and Curaçao produce insignificant quantities of salt and Curaçao mines phosphate on a small scale at Newport.

Other islands.—A small salt industry operates on the islands of Bonaire, St. Eustace, and St. Martin.

MEXICO

By J. R. KEIGHLEY

The importance of the mineral industry to the Mexican economy is indicated by the fact that, in terms of value, mineral products comprise approximately three-fourths of all exports. For more than four centuries Mexico has been one of the world's most important mineral-producing areas. During that time it is estimated that more than one-third of the world production of silver was mined in Mexico. The Republic ranks also among the world's leading producers of lead, zinc, gold, silver, copper, antimony, arsenic, molybdenum, bismuth, cadmium, fluorspar, graphite, strontium ore, and petroleum. Mexico has the second largest iron and steel industry in Latin America. Production of cement, gypsum, clays, and building materials is

pertinent to Mexico's internal economy, but reliable figures are not available.

The decline of mineral output in 1944 below the record rate of 1943 was attributable mainly to three causes. The United States Commercial Company canceled contracts for celestite, mercury, and tungsten, causing a fear among other producers that contracts covering many or all minerals would be canceled. A general strike of mining and smelter workers went into effect on June 8 when practically all mining ceased, and many properties were idle for several months before wage disputes were settled. A shortage of gasoline and the poor service given by the railroads caused concentrates and metals to accumulate at numerous places throughout the country, handicapping mining operations.

Antimony.—Mexico is second only to Bolivia in the production of antimony, with an output of 10,931 metric tons in 1944 compared with 13,682 tons in 1943. About 95 percent of the output is exported to the smelter of the Texas Mining & Smelting Co. at Laredo, Tex.

Arsenic.—Mexico's output of white arsenic dropped from 20,301 metric tons in 1943 to 15,306 tons in 1944. Production is a byproduct in the smelting of principally arsenical lead ores at the plant of the American Smelting & Refining Co. at San Luis Potosí and the American Metal Co. plant at Torreón, Coahuila. Mexico is second to the United States in production of white arsenic.

Bismuth.—Bismuth is exported principally as bismuth-lead bars produced at the reduction plant of the American Smelting & Refining Co. at Monterrey. Production of 165 tons in 1944 represented a decrease of 10 tons from that of 1943. Some bismuth ore is mined at the Rey de Bismuto mine near Culiacán, Sinaloa.

Cadmium.—The cadmium content of flue dust exported to the United States assures Mexico of second place in the world as a producer of cadmium. Considerable amounts are recovered in the United States from the treatment of zinc concentrates exported from Mexico. If this content were included with that contained in flue dust, Mexico might be the largest producer, with an estimated 2,300 tons annually.

Copper.—During World War II the copper industry was stimulated by financial concessions justifiable only during an emergency, but the increases in production effected by these measures were only moderate and will disappear when the present concessions are abolished. Production of 41,300 metric tons in 1944, of which 32,974 tons were refined copper, represented a 17-percent decrease from 1943 output. With one exception in Baja California, the principal companies are American-owned, and all the copper produced is exported to the United States.

Gold.—Production of gold in Mexico has declined steadily from 883,117 troy ounces in 1940 to 508,882 ounces in 1944. It is recovered principally from ores of other metals, and the most important producer is the Real del Monte silver mine of the Cía. de Real del Monte y Pachuca, subsidiary of U. S. Smelting, Refining & Mining Co.

Iron and steel.—Although Mexico has many iron-ore deposits, the only major source present is the Cerro Mercado deposit near Durango. The property is owned by a subsidiary of Cía. Fundidora de Fierro y Acero de Monterrey, S. A., the principal producer of iron and steel. Annual production of ore is approximately 180,000 tons containing

62 percent iron. Most of the ore is shipped to Monterrey to the Compañía Fundidora's blast-furnace plant, which has a daily capacity of 900 tons of pig iron. Production of pig iron, which has been limited by a serious shortage of coke, dropped from 147,000 tons in 1943 to 135,000 tons in 1944. The domestic demand for all forms of steel has kept the company steel plant and rolling mills working at capacity. Altos Hornos de Mexico, S. A., at Monclova, Coahuila, began producing pig iron in its new plant in 1944, output included in the figure cited above. The company has one blast furnace with a capacity of 300 tons per day.

Lead and zinc.—Mexico is the world's fourth-largest producer of lead and zinc, most of which was exported to Europe and the Far East before 1940 but to the United States since that time. More than a hundred small mines, principally in the States of Chihuahua and Nuevo Leon, sell their ores or concentrates to large American companies for refining or direct shipment in crude form. In 1944 production amounted to 7,011 metric tons of lead-in-concentrates and 178,270 tons of refined lead, and 169,717 tons of zinc-in-concentrates and 49,248 tons of refined zinc. Compared with 1943, this represented an over-all decrease of 15 percent for lead and an increase of 11 percent for zinc. Mexico has furnace-charging capacities of about 1,100,000 metric tons in five lead smelters, 294,000 tons in two lead refineries, and 90,700 tons in one zinc smelter.

Manganese.—Production of manganese ore is solely a war-stimulated enterprise that has been pushed to 29,000 tons in 1944 to supply some of the United States requirements. Only a small percentage of producers could compete on an open market. Principal output is from the Lucifer mine near Santa Rosalia and the El Galivan property near Mulege, both in Baja California.

Mercury.—The significant increase in the production of mercury from 7,376 flasks in 1939 to 32,442 flasks in 1942 was due to the rise in price. The principal mines are Nuevo Mercurio and Sain Alto in the State of Zacatecas and the Huahuaxtla in the State of Guerrero. When the price fell from \$196 per flask to \$96 in 1944, the small, high-cost enterprises closed down, and production was stepped down to 16,063 flasks.

Molybdenum.—The output of molybdenum is almost entirely from Cananea, Sonora, where a byproduct concentrate is segregated at the flotation plant of the Cananea Consolidated Copper Co. In 1943, 1,885 tons of concentrate were sent to the United States for transshipment to the United Kingdom and the U. S. S. R. In 1944 shipments dropped to 1,188 tons containing approximately 720 tons of metal.

Silver.—About one-third of the world's silver is mined in Mexico from silver ores and silver-lead-zinc ores. The most important producers are in Zacatecas, Chihuahua, and Hidalgo. Production in 1944 amounted to 76,717,515 troy ounces.

Strontium.—Strontium salts are used extensively only in time of war, and production is likely to decline when the demand for tracer bullets and flares abates. Principal production is from the Providencia mine at Villa de La Paz, San Luis Potosí. United States imports of Mexican strontium ore dropped from 10,033 metric tons in 1943 to 2,308 tons in 1944.

Tin.—Most of the 300 to 400 tons of alluvial tin produced annually is consumed domestically. The Cía. Metalúrgica de Mexico, S. A., operates a tin smelter at Tlalnepantla, near Mexico City.

Tungsten.—The two most important districts producing tungsten ores are the State of Sonora and the Ensenada area in Baja California. The increased production from 193 metric tons in 1942 to 516 tons in 1943 and 266 tons in 1944 was accompanied by a decline in grade of the concentrates exported.

Nonmetallic minerals.—Production of nonmetallic minerals is continually increasing. Salt, sulfur, gypsum, cement, and building materials are produced in substantial quantities but few reliable statistics are available. The output of fuller's earth, diatomite, kaolin, optical calcite, and semiprecious stones is also increasing.

Fluorspar.—Mining of fluorspar on a relatively extensive scale was brought about by the war. About 70 percent of the total production now comes from the Azul mine, State of Guerrero. Exports have climbed from 9,271 metric tons in 1940 to 56,450 tons in 1944.

Graphite.—United States requirements for "amorphous" graphite are met largely by imports from Mexico. Production is principally from the southern part of the State of Sonora. The United States Graphite Co. and Superior Flake Graphite Co., two companies controlled by American capital, supply a large part of the production, which amounted to 20,677 tons in 1943 but dropped to 12,977 tons in 1944.

Mica.—Unimportant production of only about 100 tons of mica annually is entirely from the Cía. Mercantil de Oaxaca, operating in the State of Oaxaca.

Coal.—The Sabinas coal field in the State of Coahuila is the major source of coal, with reserves estimated at 1 billion tons. The Cía. Carbonifera de Sabinas, subsidiary of American Smelting & Refining Co., operates by far the two largest mines in the country, Rosita No. 6 and Cloete No. 1. The coal is soft and friable, ash content is high, and moisture is 1 to 2 percent. Many other extensive coal deposits exist in Mexico, but few of these have been developed. Production dropped from 1,053,485 tons in 1943, the peak year, to 880,331 metric tons in 1944. No coal is imported into the country, but in recent years there has been a shortage of coke due to a lack of enough coke ovens.

Petroleum.—Production of 38,203,105 barrels in 1944 was 3 million barrels greater than in the previous year. The present output is not indicative of potential production but is controlled with relation to domestic requirements and export markets. The annual report also estimated present reserves at 800,000,000 barrels. The peak year for production was 1921, when approximately 193 million barrels were produced. More than half of the country's production is from the Poza Rica field, which began producing shortly before the 1938 expropriation of foreign holdings. Exploratory work and drilling increased considerably in 1944, but no new discoveries have been made in recent years.

Exports.—Mineral exports decreased with falling production in 1944. Exclusive of nonmetallics and petroleum, exports were valued at \$70,212,587, an 18-percent decrease from the previous year's total of \$86,043,019. Almost all exports were shipped to the United States. Decreases were reported in gold, silver, copper, lead, antimony,

graphite, mercury, arsenic, cadmium, tin, tungsten, molybdenum, celestite, sulfur, and coal. The most important increase was in shipments of fluorspar, which amounted to 151 percent. Shipments of bismuth, iron, manganese, and zinc were larger than in the previous year.

COSTA RICA

Gold and silver, in quantities that have dwindled since 1941 to only 3,606 and 6,167 troy ounces, respectively, in 1944, are mined by four small companies in Costa Rica and shipped in the form of concentrates to San Francisco for refining. The outlook for mining in 1945 is not promising. Salt for domestic use is the only other mineral produced.

GUATEMALA

Production of placer gold dropped from 5,058 ounces in 1939 to 126 ounces in 1944, owing largely to withdrawal of the only dredging operation in the country. Production of chromite, lead, mica, quartz crystal, mineral pigments, and sulfur is too small to be of any importance. Salt, amounting to 12,643 tons in 1944, is produced for domestic use by the evaporation of sea water and the boiling of coastal marine earth.

HONDURAS

Gold and silver.—The American-owned New York and Honduras Rosario Mining Co. at San Juancito is the only company currently producing gold and silver in Honduras. Newly acquired properties are expected to be brought into production after the present world war. Total production is exported to the United States.

A small amount of independent placer mining is done in various parts of the country.

Gold and silver production in 1944 amounted to 19,774 and 3,115,352 troy ounces, respectively, all of which was exported to the United States as usual.

Antimony.—A small production of antimony ore (amounting to 71 tons of contained metal in 1944) is mined from at least six small properties. The total output of concentrates is exported to the United States via San Jose, Guatemala.

Salt.—Salt production is steady but insignificant.

NICARAGUA

Gold and silver.—Nicaraguan exports of gold and silver to the United States, indicative of production, amounted to 219,349 and 248,529 troy ounces, respectively, in 1944, showing only a slight decrease from 1943, and the industry is expected to continue operations at even tenor during 1945. Exports are in the form of concentrates.

Although more than 2,000 gold-silver mines are recorded in Nicaragua, most of the production is supplied by five companies with mines at Jabali. In value, exports of gold and silver represent slightly more than half of the total exports of the country. Nicaragua is the leading gold-producing country of Central America.

Miscellaneous minerals.—Cement, salt, sulfur, saltpeter, limestone, building and construction stone, sand and gravel, clay, and mineral earths are produced in unimportant quantities.

Coal.—Exports of coal amounting to 1,267 metric tons in 1943 were more than double those of 1942 and have greatly exceeded imports since 1941. Coal occurs in the Departments of Leon and Carazo. Production data are not available.

Petroleum.—Geologic conditions that appear favorable to the existence of petroleum have been noted in several sections of the country. Two United States petroleum companies abandoned exploratory drilling early in 1944 but are planning a program of seismographic exploration in 1945.

PANAMA

Panama recovers about 10,000 metric tons of salt a year by the evaporation of sea water. Placer gold has not been produced since 1942, and lode mining of gold-silver-copper ores ceased in 1936.

SALVADOR

Gold and silver.—From 1940 through 1944 exports of bullion to the United States, indicative of total metal production of El Salvador, showed a decline of gold from 50,425 to 23,204 troy ounces and an increase of silver from 168,541 to 305,922 troy ounces, suggesting a decrease in grade of ore in terms of gold:silver ratio, and consequently of value, rather than a decrease in the amount of ore mined and processed. The precious metals contribute 6 percent of the total value of Salvadoran exports. Virtually all of the gold and silver produced came from the mines of five companies: Butters Salvador Mines, Ltd.; Minas Montecristo, Inc., S. A.; Compañía Minera de Oriente, S. A.; Comacaran Gold Mining Co.; and Mineral Los Encuentros.

Nonmetallic minerals.—El Salvador's nonmetallic mineral industry is small and of scarcely more than local interest. Limestone and ornamental stone, clay, volcanic ash (puzzolana), and the usual construction materials are abundant, and a few hundred tons of salt are obtainable annually from the evaporation of sea water. Mineral fuels, however, are entirely lacking.

SOUTH AMERICA ⁵

By SUMNER M. ANDERSON ⁶

ARGENTINA

The year 1944 was marked by official awakening to the danger inherent in Argentine economy that has been brought about by the disappearance of supplies of imported metals, and a campaign has been active for the purpose of stimulating every possible development and use of the country's limited mineral resources. The Government inaugurated a school for mining, assisted in the opening of a well-equipped minerals laboratory by the Argentine Trade Promotion Corporation in Buenos Aires, sponsored a mining congress and held a

⁵ Anderson, S. M., Mineral Reviews of Latin America, 1939-44: Bureau of Mines Foreign Minerals Survey, Vol. 2, No. 4, 1945 (see for more detailed review).

⁶ Export sections by A. Taaves.

mining exposition; but production in general has not increased, and that of certain minerals, such as mica and the ores of tungsten and beryllium, still depends to a large extent on demand from abroad. The Government has also initiated the erection of a blast furnace for the production of pig iron at Palpala, and the development of an iron mine at Zapla, 12 kilometers away, in the Province of Jujuy. The silica content of the ore from this mine is very high and great difficulty is anticipated in obtaining suitable pig iron from it. Argentina's steel industry has always depended heavily on imported pig and ferro-alloys and domestic and imported scrap.

Argentine economy is handicapped most by shortages of coal, petroleum, and copper. If relief comes in 1945 it will be in the form of quantitative improvement of imports rather than of the domestic supply situation.

Although complete official production statistics for 1944 have not been received, the order of value of the leading metals produced in Argentina has been reported as tungsten, lead, gold, zinc, tin, and silver. Comparable figures for the leading nonmetallic minerals are not available for 1944, but in 1942 their order of value was petroleum, cement, stone (all types), lime, salt, solid fuels, sand, mica, clays, and mineral water. In 1942, also, the value of total production of non-metallic minerals (including the hydrocarbons) was nearly six times that of the metallic, although if the hydrocarbons are excluded the value of nonmetallic over metallic minerals produced was but slight. Total over-all mineral production falls considerably short of domestic requirements, and Argentina is consequently a net importer of mineral raw materials and products.

Argentina has only two large mines, both in the Province of Jujuy. Northwest of Tres Cruces the Compañía Mineral Aguilar operates one of the world's largest zinc-lead-silver mines, and northwest of Abra Pampa the Compañía Minera Piriquitas works an alluvial tin deposit that was formerly very rich but is now approaching exhaustion. Since 1942 a part of the concentrates from the Aguilar mine have been refined electrolytically in a zinc plant at Uriburu, a suburb of Buenos Aires.

Exports.—The United States received virtually all of Argentina's exports of strategic minerals, amounting in 1943 to about 1,050 metric tons of beryllium ore, 2,252 tons of tungsten ore of 68 percent WO_3 content (or the equivalent of 2,552 tons of 60 percent WO_3 content), 78,474 tons of zinc concentrates, and 401 tons of mica. Exports of beryllium, tungsten, and zinc concentrates were higher than those of 1942 by 45, 38, and 36 percent, respectively, but those of mica showed practically no change.

BOLIVIA

The year 1944 showed a slight net decrease in the production of exportable minerals. As in former years, tin and tungsten constituted the mainstay of the Bolivian economy and contributed approximately 87 percent (72 and 15 percent, respectively) by value of total Bolivian mineral exports, which amounted to slightly more than \$US73,000,000. Minerals representing 63 percent of this value were purchased by the United States, and the bulk of the remainder was shipped to the United Kingdom in the form of tin concentrates.

One trend of the new revolutionary government which came to power on December 20, 1943, was marked by a series of wage increases and social legislation designed to offset the increased cost of living and to improve the lot of Bolivian workers. These measures are mainly at the expense of the mining industry and, coupled with the heavy tax burden, contribute immoderately to mining costs.

The United States Commercial Company continued its contracts with producers for the purchase of tin, lead, and zinc but terminated contracts for the purchase of antimony, bismuth, copper, and tungsten.

Antimony.—The termination of United States purchases was effective in reducing Bolivia from first place among the antimony-producing countries of the world to a position subordinate to that of Mexico. A decline of 58.6 percent was registered from 17,973 metric tons of contained metal in 1943 to 7,448 tons in 1944.

Bismuth.—With an average annual export record of about 13,000 kilograms of bismuth contained in concentrates over the 5-year period 1939–43, Bolivia dropped to a negligible 605 kilograms in 1944.

Copper.—Production and export of copper in 1944, amounting to 6,011 metric tons of contained metal, slightly exceeded that of 1943. Total yearly output, however, is relatively unimportant.

Gold and silver.—The gold and silver produced during 1944, all of which was exported to the United States, was entirely contained as byproduct in the ores and concentrates of other metals. Output of gold amounted to only 4,561 troy ounces, but 6,797,631 ounces of silver places Bolivia in about sixth place among the producing countries of the world and second only to Peru in South America. Straight gold-mining potentialities received a set-back in December when two contracts for the exploitation of gold in the Tipuani Rio Kaka region were abrogated by action of the National Convention and the Executive Branch of the Government.

Lead.—Bolivian production of lead dropped 21 percent from that of 1943 to 9,047 tons in 1944. Compañía Huanchaca de Bolivia is Bolivia's leading producer of zinc and silver and furnishes about one-third or more of the total output of lead.

Tin.—Tin production declined about 4 percent from that of 1943 to 39,341 metric tons in 1944. Virtually all of the tin produced during the year was from mines that have been established for 35 years or longer. The new Tainton-process plant of the Compañía Minero Unificada del Cerro de Potosi and the sink-and-float plant of Patino Mines and Enterprises Consolidated are finished but neither has as yet achieved successful operation. If technical difficulties are overcome the processes should prolong the life of the mines by increased recovery, and the Tainton process should add materially to the actual output of Potosi and possibly other complex and low-grade ores. The 1945 outlook for tin is favorable, with the expectation that production will equal or surpass that of 1944.

The tin-mining industry continued carrying a heavy tax burden, which in total amounted to approximately 25 percent of the prevailing price, or \$US 0.15 per pound of contained tin shipped.

Tungsten.—Tungsten-ore production reached its wartime peak with a 15-percent increase over that of 1943 to 7,935 metric tons (80 percent WO_3) in 1944. During the latter half of the year, however, production declined materially as the direct result of reductions in price offered by the United States Commercial Company, effective

July 1 and November 1. Rich producers will continue operations in 1945, selling by contract with private buyers. The smaller producers (two of whom failed through bankruptcy in 1944) may be expected to suspend operations in 1945.

Zinc.—In 1944 Bolivian zinc production dropped 22.6 percent from that of the preceding year to 16,319 metric tons of contained metal. Under relatively stable prices production in 1945 is expected to improve.

Nonmetallic minerals.—Mica production remains negligible. Sulfur exports fell a thousand tons from the 7,192-ton high of 1943. Shipments were made to neighboring countries. No information has been received relative to operations in the purely domestic cement, stone, clay, and salt industries during 1944. Apparently no effective attempt has been made to exploit diamond-bearing sediments reported in Caupolican Territory in the northeastern Bolivian Andes.⁷

Petroleum.—The 6-percent decline in production of crude petroleum in 1944, as compared with 1943, was attributable to the lack of oil-well supply materials and equipment resulting from wartime restrictions on supply distribution. A decrease in refinery output was attributable to deterioration of distribution facilities.

Of the 314,467 barrels of crude produced in 1944, 86,311 barrels were exported to unreported destinations; about 192,350 barrels went to domestic refineries and the balance to use in crude form, stock, and losses. Bolivia's imports of petroleum products normally exceed crude production.

Exports.—With minor exceptions, the mineral products of Bolivia are sold in export. In 1944 the United States purchased all the copper, gold, and zinc produced, virtually all the antimony, tungsten, and silver, 51 percent of the tin (the remainder destined for England), and 42 percent of the lead. About half of the lead, all the mercury, a large part of the sulfur, and most of the crude petroleum normally exported goes to Argentina.

BRAZIL *

During the war years Brazil has made an effective contribution of strategic minerals to the war industries of the United States and Great Britain. In 1944 Brazil was the source of virtually all the United States imports of quartz crystal, 53 percent of the tantalite, 47 percent of the beryllium ore, 45 percent of the rutile, 41 percent of the tungsten ore, 13 percent of the manganese ore, 10 percent of the zirconium ore, and relatively minor quantities of metallurgical-grade chromite, ilmenite, zirconium ore, industrial diamonds, mica, and talc. Production was generally considered to be at the maximum level for available equipment and facilities; and, with the exception of coal, iron ore, gold, construction materials, fertilizers, and gem stones, mineral activities were directed primarily toward procurement of strategic materials related to the war effort of the United Nations. All purchase agreements between the United States Commercial Company and Brazilian producers expired in June 1944 and were not renewed, but purchasing has continued by United States

⁷ Oppenheim, Victor, *Diamonds in the Northeastern Bolivian Andes*: Econ. Geol. vol. 38, No. 8, December 1943, pp. 658-661.

* Review prepared from data submitted by E. I. Brown, U. S. mineral attaché, Rio de Janeiro.

and United Kingdom Government agencies and by private commercial enterprises, and the United States Commercial Company has granted loans, rented equipment, and given technical aid to expedite and increase the production of such strategic materials as quartz crystal, mica, beryl, and tantalite. The attainment of higher export tonnages was prevented by transportation facilities that are inadequate, slow, unreliable, and expensive and—particularly for tantalite, beryl, and quartz crystal—by obstructive legislation relating to prices, procurement, and limitation of exports.

With the end of the war in Europe and considerable relaxation of demand, the year 1945 presents the problem of finding markets for those raw material products for which production capacities have been expanded but which are no longer required in such exceptional quantities by the war industries. The type of direction and action applied to this problem will determine the extent to which certain of these industries will be able to continue producing. In general, the abundance of easily accessible surface deposits, the presence of reserves of resources in which the United States is deficient, and very low labor costs all favor a satisfactory solution to the problem of postwar mining development. Obstructing a favorable outlook, on the other hand, are the facts that (1) most deposits are small and not adaptable to large-scale mechanization; (2) transportation facilities are inadequate; (3) Brazil is badly deficient in fuel and power; (4) Brazilian capital and enterprise in general is not interested in mining; and (5) mining legislation and taxation are unattractive to foreign capital.

Bauxite.—Bauxite deposits in the Poços de Caldas district are exploited by Campanhia Brasileira de Alumínio, which in August 1944 began producing alumina, C. P. aluminum sulfate, and sulfuric acid at a new plant at Rodovalho, about 80 kilometers from São Paulo. The plant does not yet have facilities for reducing the alumina to aluminum metal. A deposit in Ouro Preto is utilized by a nearby plant of Electro-Química Brasileira, S. A., which initially produced aluminum metal in March 1945, though at a cost said to be abnormally high. A third plant is planned to be located near Campos in the State of Rio de Janeiro to use bauxite from the State of Espírito Santo. Hydroelectric power is not abundant but is believed to be adequate to produce Brazilian aluminum requirements. Production of bauxite in 1944 has been estimated at only 5,000 metric tons.

Beryl, tantalite, and columbite.—These ores are mined together by crude open-pit methods from pegmatite deposits scattered throughout northeastern Brazil. Columbite is also produced from an alluvial deposit near Pouso Alegre in the State of Espírito Santo. Although production tonnages are small (less than 2,000 metric tons annually for the three ores combined), they represent the major portions of United States requirements for beryl and tantalite and a small contribution to the needs for columbite.

Chromite.—Production of chromite, which was limited to a few hundred tons of hand-sorted lump ore yearly between the first and second world wars, reached a peak of 7,813 tons (as indicated by exports) in 1943. The ores range from about 30 to 50 percent Cr_2O_3 . Mining is from open pits without benefit of any major mechanical equipment.

Gold.—Underground gold mines employ about 13,000 workers in the States of Minas Gerais, Paraná, and Rio Grande do Sul and

supply the major portion of Brazil's output of gold. Silver and arsenic are also recovered from the arsenopyrite ores. Placers in at least 10 States comprise the other important source of gold, and it is estimated that in normal times about 50,000 independent miners work these alluvial deposits. The law requires that all gold produced be sold to the Banco do Brazil, but hoarding and smuggling have been practiced on a fairly large scale in 1943 and 1944, and bank purchases of placer gold are believed to be short of production by about 32,000 troy ounces in each of those years. Production has declined steadily from 264,322 troy ounces in 1940 to an estimated 178,300 ounces in 1944.

Iron and steel.—Iron ore is Brazil's most valuable mineral resource and one of the world's outstanding reserves for future supply, estimated at several billion tons and including a billion or more tons of hard hematite ore that exceeds 60 percent iron and is very low in phosphorus and silica. The important hematite deposits are in the State of Minas Gerais. Unworked but potentially important deposits elsewhere include magnetite ores in São Paulo, Santa Catarina, Paraná, Goiaz, and Matto Grosso and a newly discovered large hematite deposit in the new territory of Amapa. Poor transportation facilities have greatly hampered large-scale development of the Minas Gerais deposits, but ore at Caue Peak near Itabira is now being developed and provided with improved railroad transportation and a loading dock at the port of Victoria. An active and expanding charcoal-iron and steel industry is based on 24 small blast furnaces which produced a record 291,211 tons of pig iron in 1944. This pig iron, in turn, was in part converted into 219,304 tons of steel ingots from which 164,656 tons of rolled steel products were made. The new 300,000-ton iron and steel plant of National Steel at Volta Redonda is to be supplied with ore from the open-pit mines near Congonhas do Campo and will produce approximately 225,000 tons of rolled steel products annually when it attains full capacity.

Manganese.—Manganese deposits in Brazil have been rated second to iron in importance. Production amounting to 203,751 metric tons in 1944 has come principally from central Minas Gerais, and Companhia Meridional de Mineração, Ltda., a subsidiary of the U. S. Steel Corp., is the leading producer. The largest-known manganese deposit in the Americas, estimated to contain 30,000,000 tons of high-grade manganese ore capped by an important hematite ore body, is on the Urucum property near Corumba in western Mato Grosso, almost on the Bolivian border. Large capital expenditure will be required before large-scale shipments can be made profitable over the long river route to Montevideo or Buenos Aires.

Ferromanganese is made in two electric furnaces owned by Companhia Electro-Chimica at Saremeha near Ouro Preto, Minas Gerais.

Nickel.—Nearly a dozen deposits of nickel ore consisting of silicates of the garnierite type are known in the States of Minas Gerais, Goiaz, and Bahia, but only one—at Livramento, Minas Gerais—has been worked. There a 2-percent nickel ore is treated by direct reduction in a 20-ton electric furnace to yield a 20-percent ferronickel. The American Smelting & Refining Co. has abandoned as unprofitable its 2-year attempt to develop Brazil's largest known reserve of nickel ore near São José de Tocantins in central Goiaz.

Tin.—Driven by wartime necessity, Brazil started producing tin for the first time in 1940. Principal production was developed in the valley of the Rio das Mortes, Minas Gerais, chiefly by panning alluvial and eluvial deposits. At the 1943 peak, 350 tons of metallic tin were produced. Most of the smelting was done locally, but small amounts were reduced at São Paulo and Rio de Janeiro. Tin produced under these conditions, regardless of cheap labor, sold for \$1.00 to \$1.15 per pound while the world price was \$0.60.

Titanium ore.—Rutile is panned or sluiced from alluvial deposits over a large area of central Goiás and in southern Minas Gerais. Ilmenite is an important constituent of beach sands in the States of Bahia, Espírito Santo, and Rio de Janeiro, where it is associated with monazite. Production of ilmenite has declined in recent years, and at present there is not much interest in it.

Tungsten ore.—Wolframite is mined in the States of São Paulo and Rio Grande do Sul. Output of the underground Inhandjara mine in São Paulo, the largest producer, is supplemented by small open workings near Encruzilhada, Rio Grande do Sul. Scheelite was first discovered in February 1942 in the Borborema Plateau zone in the States of Rio Grande do Norte and Paraíba. Mining reached its peak in August 1943, and the easily mined scheelite was quickly worked out. Production has declined, and shippers must now stand deductions for impurities. Total shipments of tungsten ore attained their peak in 1944 with 2,221 metric tons, 60 percent WO_3 .

Zirconium.—Zirconium ore is recovered from alluvial, eluvial, and vein deposits in São Paulo and southwestern Minas Gerais. A minor amount is also a byproduct of workings of monazite beach sand. Brazilian production dropped from about 17,000 metric tons in the peak year 1942 to 2,152 tons (shipments) in 1944.

Asbestos.—Asbestos production is small and for domestic use only.

Barite.—The barite industry was formerly unimportant but is changing radically with the development of a series of veins at Morro do Serrate, São Paulo. Production amounted to only 300 tons in 1944 but is now proceeding at the rate of about 100 tons per month, and the owners are operating a plant in São Paulo for the production of barium carbonate and barium nitrate. A larger and potentially more important deposit is that of Ilha Camamū, Bahia. Reserves of 1,000,000 tons of barite of 88 to 98 percent $BaSO_4$ have been reported. The deposit is now being developed by Pigmentos Minerais, S. A., which plans to provide a dock and conveyor for bulk loading of ships directly from the plant stock pile and to produce insecticides, paints, and barium compounds for the Brazilian market and a surplus of raw or ground barite for export.

Building materials.—Building materials, such as cement brick, tile, marble, sand, lime, gypsum, and crushed stone, appear to have been in heavy demand recently, but information relative to production and production facilities is incomplete.

Diamonds.—Normally Brazil produces less than 4 percent of the world output of diamonds, and in 1944 it supplied less than 1.5 percent of total diamond imports into the United States. From May 14, 1941, to January 25, 1945, an agreement was in effect between the United States and Brazil whereby Brazil's entire exportable surplus of diamonds went to the United States exclusively. Diamonds are washed from stream gravels in the States of Mato Grosso, Minas

Gerais, Bahia, Goiaz, Amazonas, Para, Paraná, and São Paulo. All of the carbonados, or black diamonds, come from Bahia. In 1944 an estimated 38,000 nomadic workers washed alluvial gravels for 300,877 carats of diamonds, including 38,372 carats of carbonados. A diamond-cutting industry established in Brazil in the past few years will require the importation of rough stones, or many of the refugee cutters will have to return to Europe after the war.

Graphite.—The Companhia Nacional de Grafite Limitada has recently abandoned a deposit worked for several years in São Paulo in favor of one of better grade near Itapeverica, Minas Gerais. A flotation mill with a capacity of 48 tons per month of graphite averaging better than 85 percent carbon has been installed. In 4 months of 1944, 280 metric tons of graphite concentrates were produced. What percentage of output is crucible-grade is not known.

Lithium.—Byproducts of pegmatite mining in 1944 included 600 metric tons of amblygonite carrying 8 percent Li_2O , sold and shipped to England.

Magnesite.—Deposits of magnesite were unknown in Brazil 6 years ago, but the first discovery in Bahia was followed by another apparently larger discovery in Ceará in 1940. Neither of these has been exploited on a large scale, yet it seems reasonably probable that they may prove to be one of the largest known reserves of magnesite, if not the largest, in the world. Magnesita, S. A., owns the deposit near Brumado, Bahia, and expects to ship over a new railroad to its refractory plant in Belo Horizonte. A stack kiln is being constructed at Brumado to dead-burn the magnesite before shipment. At José de Alencar, Ceará, two furnaces similar to lime kilns have been built for calcining magnesite which is sold in Rio de Janeiro and São Paulo. In 1942, 8,000 tons are reported to have been shipped out.

Mica.—Brazil produces mica from pegmatite deposits in the States of Goiaz, São Paulo, and Bahia, but the chief producing State is Minas Gerais, where about 500 properties engage some 12,000 workers in the mining, transport, trimming, and sorting of about a thousand tons of ruby muscovite annually, or double the output of 1938. During 1942 hundreds of trimmers, qualifiers, and inspectors were trained to Indian or Universal standards, with resulting improvement in quality of the mica shipped. Technical conditions are favorable for a 1945 production equal to the 941 tons shipped in 1944, but commercial conditions are contrary.

Monazite sands.—Monazite is produced principally from beach sands at Guarapary in Espirito Santo. The monazite is said to have a thorium content of 6.31 percent. Monazite production amounted to only 870 tons in 1944.

Phosphate.—Two types of phosphate deposits are known in Brazil. The largest, estimated at 10,000,000 tons, is a bauxite deposit at Ilha Traíra, Maranhão, that is unsuitable as an aluminum ore because it carries 20 to 30 percent P_2O_5 . An economic process for converting the raw material to soluble superphosphate has not yet been devised, but the Departamento Nacional da Produção Mineral is experimenting with a process that it believes will be successful. The other known sources of phosphates, and only ones that have been worked, are apatite deposits. Two of these in São Paulo annually supply about 5,000 tons of ore to a Government plant near Ipanema that concentrates

the apatite and produces phosphate fertilizer, though with only partial success.

Pyrite.—About 3,000 tons of pyrite are produced annually by three mines in the vicinity of Ouro Preta, Minas Gerais, and from vein deposits near Rio Claro in the State of Rio de Janeiro. The pyrite contributes to the production of sulfuric acid in five known plants.

Quartz crystal.—Brazil is the world's best and largest source of quartz crystal of piezoelectric quality. It occurs in relative abundance in the States of Minas Gerais, Goiaz, and Bahia, and most of the production is from widely scattered unorganized sources and shallow surface deposits worked by hand. Final grading and classification are done in Rio de Janeiro and Bahia, where the United States Commercial Company operates laboratories. Ninety percent of all the quartz produced reaches Rio de Janeiro or Bahia from the interior through a succession of storekeeper dealers, to be exported 1 to 6 months later, after sorting. Export figures are consequently the only index to production, which undoubtedly reached its all-time peak in 1943, when shipments amounted to 2,411 metric tons, and dropped to 1,122 tons in 1944. The United States Commercial Company has announced that it will continue purchasing during 1945. This will give some degree of stability to a market that is certain to decline after the war.

Salt.—In 1944, 453,600 tons of common salt were produced for domestic use by the solar evaporation of sea water in 12 States.

Gem stones (except diamonds).—The volume of production of semi-precious stones has been reduced during the war by diversion of labor to the mining of more strategic minerals, but more cutting is being done by the refugee cutting industry, and prices are higher than normal. More gem material comes from the pegmatites of Minas Gerais than from any other State and includes fine-quality amethyst, aquamarine, green and red tourmaline, garnet, white, blue and yellow topaz, citrine, opal, smoky quartz, chrysoberyl, chrysoprase, andalusite, agate, and undoubtedly others.

Coal.—The principal operating coal fields are in Rio Grande do Sul and Santa Catarina. A small field is under limited production in Paraná, and a new field was discovered recently in São Paulo. Production is considerably below domestic needs, which were supplied in 1943-44 as shown in the following table.

Brazilian coal supplies, 1943-44, in metric tons

Production by States (clean coal):	1943	1944
Rio Grande do Sul.....	925, 759	807, 784
Santa Catarina.....	584, 234	540, 874
Paraná.....	40, 000	76, 000
São Paulo.....	6, 000	8, 500
Total Brazilian production.....	1, 555, 993	1, 433, 158
Imports ¹	651, 575	677, 000
Total supply.....	2, 207, 568	2, 110, 158
Exports.....	57, 269	16, 740
Total supply available for domestic use.....	2, 150, 299	2, 093, 418

¹ 1 ton of imported coal is considered to equal 1.4 tons of Brazilian coal in heating value.

Petroleum.—Two small oil fields in the State of Bahia produced 125,000 barrels of crude petroleum in 1944. Operations started in the Lubato field in 1939 and at Candeis in 1940. Reserves have been estimated at only about 1,000,000 barrels, and prospects of important future production are not encouraging.

Export.—Complete mineral-export statistics showing countries of destination are not available for the past 2 years, but information has been presented showing that exports to the United States in 1943 and 1944 rose from 46 to 47 percent of total exports in tonnage and from 51 to 53 percent in value, indicating very little change in proportional distribution. On the basis of actual quantities shipped to the United States in the 2 years, manganese dropped 47 percent, quartz crystal 44 percent, and diamonds 5 percent. The portion of certain mineral exports destined for the United States in 1944 is indicated in the following table.

Brazilian exports of selected minerals in 1944

Mineral	Total exports (metric tons)	Total to U. S. (metric tons)	Percent of total to U. S.
Beryl ore	1,185	1,185	100
Chromium ore	4,721	4,721	100
Ilmenite	2,500	2,500	100
Tantalite	254	254	100
Tungsten ore (60 percent WO ₃ equiv.)	2,221	2,221	100
Carbonados (carats)	10,795	10,795	100
Manganese ore	146,983	146,763	100
Rutile (titanium)	1,564	1,544	99
Zirconium ore	2,152	2,117	98
Diamonds, cut and rough (carats)	192,185	185,850	97
Quartz crystal	1,122	863	77
Mica	941	682	73
Clay	486	135	28
Iron ore	82,895	2,506	3
Pig iron	4,242		
Ferromanganese	1,228		
Graphite	199		
Bauxite	2,979		
Coal	16,740		

BRITISH GUIANA

Bauxite.—The decrease in bauxite production and exports—59 and 54 percent, respectively, from the peak year 1943—was the inevitable consequence of the improved military position of the United Nations which resulted in some relaxation of the demand for aluminum. All 1944 production, amounting to 928,178 metric tons, was from the Demarara Bauxite Co., Ltd.

Gold and diamonds.—Production of gold and diamonds in 1944 dropped 35 and 17 percent respectively, from the output in 1943, continuing a downward trend that started for gold in 1939 and for diamonds during or before 1930. Activity of the only two organized gold producers, Cuyuni Goldfields, Ltd., and British Guiana Consolidated Mining Co., is believed to be fairly well stabilized, and the deterioration of exports to only 7,571 troy ounces in 1944 is attributable largely to temporary and gradual abandonment of gold operations by individual prospectors in favor of more lucrative wartime employment.

Diamond production, which depends wholly upon an estimated 1,500 independent individuals, has declined for the same reason and because of depletion of the more readily available deposits. In 1944

exports dropped to 13,911 carats. With decreased employment in other lines in 1945, it is anticipated that production of gold will reach about 10,000 troy ounces and diamond production about 15,000 carats.

Distribution of exports.—British Guiana continues to be Canada's chief source of bauxite. In 1944, 95 percent of bauxite exports went to Canada, 4 percent to the United States, and 1 percent to the United Kingdom. The United States received 98 percent of the gold and 30 percent of the diamonds exported in the same year, Brazil 2 percent of the gold, and the United Kingdom 70 percent of the diamonds. All of the known mineral production of British Guiana except granite is eventually sold in export.

CHILE

Copper.—Chilean production of refined copper in 1944, for all practical purposes, was the same as in 1943 but may have established a new all-time high by a small margin over the 489,320 metric tons recorded in that year. The contract for the delivery of copper by the three large companies to the United States Commercial Company was renewed to cover the first quarter of 1945. Chile is the world's second largest producer of copper, and the bulk of its output goes to the United States, which leads the world in both production and consumption. Most of the mine production and all of the refining is done by three American-owned companies at Chuquicamata, Portrerillos, El Tiente, and Caletones, but two small custom smelters of Chilean ownership have been operating at Chagres and Naltagua, and about 650,000 tons of ore a year are broken from nearly 100 small mines throughout the country. Failure of the United States Commercial Company to extend its purchasing agreement with small producers is expected to force closure of most of these small mines and consequently of the custom furnaces, with a resulting cut of about 25,000 tons of copper. With this exception the industry is expected to continue operations on a prosperous scale through at least the first half of 1945. About 98 percent of the copper exported is in the form of refined and blister bars; the balance is contained in ores, concentrates, and other crude forms. Well over 90 percent of all the copper produced is exported.

Gold and silver.—From incomplete preliminary figures for 1944, a slight increase over 1943 gold production of 269,807 ounces is indicated, though not over 1941 output. Improved economic conditions in Chile have been reflected in a declining production of placer gold, as much of the placer exploitation represents depression activity, but this has been offset to some extent by increased production of copper, from which a large proportion of total gold output is recovered as a byproduct. In addition, about 25 percent of the total comes from 10 principal and several small gold-lode mines. Silver production, which amounted to 1,093,543 ounces in 1943, follows the same general trends as gold, with virtually no mining being conducted primarily for silver. About 40 percent of the silver output is contained in blister copper, 5 percent in copper concentrates, 20 percent in gold concentrates and precipitates, 30 percent in gold-copper-silver ores, and only 5 percent in primary silver ores that also carry values in arsenic. Chile is the second largest gold and fourth largest silver producer in South America.

Iron and steel.—The Bethlehem Chile Iron Mines Co. operates the only iron mines in Chile at El Tofo in the Province of Coquimbo. Normal production is roughly 1,600,000 metric tons annually, but no ore has been exported to the United States since 1942; production dropped to about 15,400 metric tons in 1944, all of which was shipped to Chile's only iron and steel plant at Corral, owned by Cia. Electro Siderurgica y Industrial de Valdivia. With pig iron from its own furnaces mixed with scrap this company produces annually about 48,000 metric tons of billets and blooms, reinforcing and merchant bars, steel strip, and iron and steel castings. The output of this plant is partly sold in export to Argentina, but most of it supplements Chilean imports of semifinished iron and steel products that are sold to local manufacturers. During 1944 considerable attention has been given to a project for the erection of a new iron and steel plant to be located on San Vicente Bay near Talcahuano and Concepción and operated by a company to be known as Cia. de Acero del Pacifico. Production will be 180,000 metric tons of pig iron and its derivatives annually from ore to be supplied by El Tofo mines.

Manganese.—Manganese ore, which attained peak production of 114,074 metric tons in 1943, is reported to have experienced a poor year in 1944. Production in recent years has been from the Provinces of Coquimbo, Atacama, Antofagasta, and O'Higgins. Production is expected to decline with the end of World War II but may be revived to meet needs of the proposed iron and steel industry.

Mercury.—Mercury production rose from 100 flasks in 1939 and 1940 to 2,563 flasks in 1943, with no report received on output in 1944. The only known production is from cinnabar disseminated in gold ore from the Punitaqui mine in the Province of Coquimbo.

Molybdenum.—Molybdenum occurs in ores of the three big copper companies but is known to be recovered only at El Tiente mine of the Braden Copper Co. Under wartime demand production was pushed from 30 tons of molybdenum-in-concentrates in 1939 to 680 tons in 1943, with the probability that the 1944 figures approached the 1,000-ton mark.

Mineral salts.—Chile's richest source of nonmetallic mineral wealth is the northern desert of Antofagasta Province, which contains extensive beds of such natural salts as sodium nitrate (Chile saltpeter), potassium nitrate, sodium sulfate, sodium chloride (common salt), borax, calcium sulfate, magnesium sulfate, potassium chloride, and sodium carbonate. The steady decline of nitrate production from 1,437,451 metric tons in 1940 to 998,534 tons in 1944 has been attributed to the shipping shortage and the greatly increased capacity in the United States for the manufacture of synthetic ammonia. The same period has seen a parallel decrease in the production of crude iodine, which is a byproduct of the nitrate purification process, while sodium sulfate has improved its position with a better market. Nitrate operations are controlled and quotas set by the Chilean Nitrate & Iodine Sales Corporation, a Government agency.

Sulfur.—Seven principal and various small companies produce sulfur from the volcanic border region adjacent to Bolivia and Argentina, at a rate of about 32,000 tons a year. In addition to supplying domestic requirements, an appreciable export trade has been built up with neighboring countries, especially Argentina and Brazil.

Phosphate.—Production of phosphate rock (apatite) in the Province of Coquimbo has become well-established during the war years and probably passed the 40,000-ton mark in 1944. Sociedad Fabrica de Cemento el Melon is the principal producer, and Cia. Fosfatos de Chile the only other.

Miscellaneous minerals.—Limestone is regularly quarried for building stone, agricultural use, and the manufacture of cement and lime; gypsum for the manufacture of cement and plaster; and clay for cement and for pottery. Salt is recovered from sea water and from desert deposits. Production of mineral pigments and kieselguhr has been reported irregularly. Production of feldspar, quartz, and talc in small quantities was reported for the first time in 1943.

Coal.—Estimates indicate that coal attained an all-time peak production of 2,035,000 metric tons net weight (2,279,693 metric tons gross weight) in 1944. Operation of the two principal coal mines, Lota and Schwager on the Gulf of Arauco, is supplemented by relatively small-scale exploitation of bituminous reserves in the Province of Arauco.

Exports.—Exclusive of iodine, iron ore, and coal, for which figures of shipments have not been reported, Chile exported 1,674,432 metric tons of crude and refined minerals in 1944, of which 1,224,147 tons (73 percent) went to the United States, as against 1,605,293 tons of equivalent materials in 1943, of which 1,183,528 tons (74 percent) went to the United States, showing a slight change in tonnage shipped but no appreciable change in ratio of major distribution.

Normally the value of mineral exports constitutes approximately 83 percent of total Chilean exports.

COLOMBIA

Precious metals.—Colombia is the leading country in South America in the production of gold but takes sixth place in the output of silver. It is the only South American producer of platinum and in the entire world is surpassed only by Canada, Union of South Africa, and probably the Soviet Union. Production of all three metals has been declining moderately but steadily since the peak year 1941.

In 1944, 553,330 ounces of gold and 197,323 ounces of silver were mined together from many placers and lode deposits scattered over 15 Departments and Territories, of which the Department of Antioquia supplied nearly two-thirds of the total output of both metals. About 60 percent of production is from placers and 40 percent from lode mines. Colombia is estimated to contain about 35 percent of the total gold reserves of South America.

Platinum, in the amount of 34,259 ounces in 1944, is also mined with gold, chiefly from streams on the Pacific slope, and about 65 percent of the output is the product of the South American Gold & Platinum Co., which operates several dredges along the San Juan River up from Buenaventura.

Iron and steel.—A small iron furnace at Capitanes has been producing about 1,500 tons of pig iron annually from local siderite ore for the past 3 years, for sale to domestic foundries.

A new steel plant in Medellín, operated by the Empresa Siderúrgica, S. A., apparently started experimental runs in 1942 but did not achieve production of steel on a commercial scale until 1944, when it

began rolling its first reinforcing bars. The plant has two electric furnaces and a third larger furnace on order that will raise the capacity to 30 tons a day. Aside from steel, the furnaces are reported to have been producing cast iron during 1943 for the foundries of Medellín. Thus far the furnaces have been using scrap metal only; but the stock is approaching exhaustion, and the company is contemplating utilization of an iron-ore deposit at Paz del Río, which has been studied extensively during the past year. Chromite, manganese, limestone, and clay are obtained locally. The plant produces its own refractory brick and operates two rolling mills.

Emeralds.—Emerald mines in the famous Muzo district have not reported production since 1934 but are believed to be operating fairly regularly. The Chivor mines were leased by the Government to Chivor Emerald Mines, Inc., in September 1937 but are not known to have been operated since the close of 1940. The Government is said to have accumulated a large stock of emeralds, and sales and exports have no essential relationship to production in any given time period. Both the mining and marketing of emeralds are under strict Government control.

Miscellaneous minerals.—Limestone, gypsum, and clay are quarried for the production of cement. Salt is recovered from sea water and from eight mines. Activity of the United States Foreign Economic Administration in 1942–44 resulted in the production of very small quantities of lead, quartz crystal, mica, and optical calcite. Exploitation of these minerals, with the probable exception of lead ore, is not expected to survive the war.

Coal.—Coal production has risen steadily, beginning in 1941, to pass the half-million-ton mark in 1944, but the figure fell some 11,000 tons short of the 521,453-ton record achieved in 1940. Mines are fairly numerous near Bogotá and throughout the Cauca River Valley between Medellín and Cali. Most of the coal mined is bituminous, and reserves are known to include subanthracite and anthracite. Colombian coal is considered the best in South America, the ash content of some veins analyzing less than 10 percent. Exports have risen from nil in 1940 to nearly 3,000 tons in 1944, with Brazil the principal customer. The bulk of the coal produced is consumed within the country, including a fair portion that is converted to coke.

Petroleum.—In 1944 Colombia produced 22,647,476 barrels of crude petroleum, of which 18,561,431 barrels were exported and 3,854,742 barrels refined within the country. Comparable figures for 1943 showed 13,261,065 barrels produced, 10,723,862 exported, and 3,427,718 refined.

The Tropical Oil Co. sends approximately 50,000 barrels of crude a day from wells in the De Mares concession through its refinery at El Centro, and the refined products are distributed throughout Colombia. Andian International Corp. is the pipe-line company that pipes crude from the De Mares concession to Cartagena for export.

Colombia Petroleum Co. produces about 14,000 barrels of crude daily from the Petrolea and new Tibú-Socado fields in the Barco concession and operates a small topping plant of 500 barrels daily capacity that supplies gasoline and gas and fuel oil to the Barco concession and to marketing areas surrounding Cúcuta. Crude for export is transported over the pipe line of South American Gulf Oil Co. to Corveñas, southwest of Cartagena.

Cía. de Petróleo Shell de Colombia has been producing crude since 1941 from the Casabe concession on the Magdalena River and had 25 wells by the end of 1944. Exploration of part of the company holdings in nine Departments and Territories also led to minor production from the Difficil concession in 1944. Crude for export from the Casabe concession is to be carried to Cartegena through the pipe line of the Andian International Corp. as soon as a line connection from the Shell field is completed. Shell has no Colombian refinery.

Socony-Vacuum Oil Co. of Colombia has started production from two small wells (200 barrels per day each) on the Cantagallo concession in the Magdalena Valley.

These four producers and four other American oil companies are actively engaged in geological and geophysical prospecting for new fields and extensions of established producing areas. The combined holdings of nine American oil companies cover approximately 10,000,000 hectares, or 38,600 square miles, which amount to about 8.7 percent of Colombia's total area.

Exports.—Complete official Colombian export figures for 1944 have not been reported. United States official figures record no imports of gold or silver from Colombia in 1944 but do show 35,320 troy ounces of platinum, representing 11 percent of total imports of that metal and slightly more than Colombia's total production for the year. Colombia's small total shipments of 1,094 pounds of quartz crystal and 1,423 pounds of mica went to the United States.

Of the 18,561,431 barrels of crude petroleum exported in 1944, the United States imported 7,544,747 barrels, representing approximately 40 percent of Colombia's shipments and 16 percent of total United States imports of crude from all sources. Judging by past performance the bulk of the remainder of Colombian crude exports may be presumed to have been destined to Canada and Aruba.

ECUADOR

Metal mining.—Except for placer operations, the mining of gold, silver, copper, and lead in Ecuador is confined to the South American Development Co. at Portovelo and the Cotopaxi Exploration Co. at Macuchi. The Portovelo mine is Ecuador's largest producer of gold and the Macuchi mine the largest producer of silver and copper. The ores contain some lead and insignificant quantities of zinc. In 1942 the Cotopaxi Exploration Co. completed and started operating a small smelter at Macuchi, which recovers copper in the form of blister. All of the blister and concentrates are exported to the United States. Operation of the Portovelo mine in El Oro Province was paralyzed at the end of the year by flooding, followed in January 1945 by break-down of one of the two hydroelectric plants. The year 1944 was a difficult one for both companies because of the stabilized price of gold and silver against increased wages and cost of materials. Gold recovered from placer operations widely scattered throughout the country is sold in accordance with law to the Central Bank of Ecuador. Metal mining in 1944 produced 84,234 ounces of gold, 376,565 ounces of silver, 3,720 metric tons of copper, and 406 tons of lead.

Nonmetallic minerals.—Limestone and gypsum from Guayas Province and fuel oil from local fields are used for the manufacture of

cement, which reached an all-time high of 35,096 metric tons in 1944.

Production of 35,958 tons of marine salt for local consumption in 1944 was well in advance of tonnage in any of the preceding 5 years.

Crude sulfur of volcanic origin is produced in amounts of less than 100 tons annually.

Production of china clay, geyserite, coal, and iron oxide is small and unimportant. The United States has received some sample shipments of quartz crystal from Ecuador, but production on a commercial scale is not anticipated.

Petroleum.—Ecuador produces petroleum in excess of local requirements, and considerable quantities are customarily exported to other countries. Anglo-Ecuadoran Oilfields, Ltd., a British-owned concern, supplies more than two-thirds of the total production. The remainder is contributed by the few wells of six other companies. At present, production is confined to Santa Elena Peninsula, but intensive exploration is being conducted elsewhere by the International Ecuadoran Petroleum Co. and the Shell Oil Co. Total production amounted to 2,892,190 barrels in 1944.

In addition to crude petroleum, gasoline is liquefied from natural gas, and various products are refined at a moderately large plant of Anglo-Ecuadoran Oilfields, Ltd. at La Libertad and a small refinery of Ecuador Oilfields, Ltd., at Cautivo.

Exports.—The United States customarily receives all of Ecuador's exports of metals and metallic concentrates, with the possible exception of placer gold and silver, for which export figures have not been reported. Small shipments of salt and sulfur have been made to neighboring South American countries. Before World War II Uruguay and France were the principal destinations of Ecuador's surplus crude petroleum, with Brazil, Japan, England, and Argentina receiving smaller amounts. Since the beginning of the war Uruguay, Argentina, and Brazil have received larger portions, and in 1943 they were the only importers of Ecuadoran crude. Distribution of natural gasoline by countries has not been reported.

FRENCH GUIANA

French Guiana has no mineral production other than placer gold, which has steadily declined to 18,440 troy ounces in 1944, about half the prewar output. Bauxite deposits are extensive but undeveloped.

PARAGUAY

Paraguay has no established mining or mineral industry.

Of great interest to the petroleum industry is the exploration work now under way in the Chaco by the Union Oil Co. of California. Its contract with the Paraguayan Government is unique in several respects and may well serve as a pattern for future agreements between American oil companies and foreign governments.

PERU*

Peru ranks among the world's leading producers of silver, vanadium, and bismuth and lists gold, copper, lead, zinc, tungsten, and molybdenum among its important metals, with white arsenic rapidly ap-

* Review prepared from data submitted by W. O. Vanderburg, minerals attaché, Lima.

proaching world importance. Petroleum and its products lead the nonmetallic field, and coal, cement, and lime are produced in appreciable quantities. Crude gypsum, clay, and the usual construction materials are produced regularly but in quantities that are not officially reported.

The absence of spectacular expansion during the war places Peru in a favorable position for facing the problem of conversion to peacetime economy without serious difficulty and with little, if any, important shift of markets. The industrial capacity of Peru for the use of metals is very limited, and most of the mine and smelter products are sold in export.

Antimony.—Antimony is obtained from about 70 small mines scattered throughout seven departments. Most of the ore goes to the Oroya smelter, where the Cerro de Pasco Copper Corp. completed a special recovery plant in August 1942. Production of antimony in all forms rose from 847 metric tons in 1939 to 2,681 tons in 1943 and dropped to 1,050 tons in 1944. Sales in recent years have been to the Metals Reserve Company and its successor, the United States Commercial Company.

Arsenic.—In June 1943 the Oroya plant of Cerro de Pasco Copper Corp. began commercial production of white arsenic that reached 6,900 tons in 1944 but failed to attain 800 tons monthly during 1943–44 as contracted for with the United States Commercial Company. The oxide is derived chiefly as a byproduct from arsenious copper and lead ores.

Bismuth.—Peru leads the world in production of bismuth, which occurs as an auxiliary metal with ores from the Colquijirca, San Gregorio, and Cerro de Pasco mines. Bismuth metal has been extracted and refined from Peruvian ores at the Oroya smelter since 1932. Production reached its peak at 483 tons in 1943 and dropped to 416 tons in 1944.

Cadmium.—Peru's cadmium production, amounting to 3,653 and 2,174 kilograms, respectively, in 1943 and 1944, comes from lead-zinc ores of the Cercapuquio mine and zinc concentrates of the Cerro de Pasco Copper Corp. Recovery of the metal in refined bars was begun at the Oroya plant early in 1942.

Copper.—The Cerro de Pasco Copper Corp. supplies about 60 percent of the total copper production of Peru. The remaining 40 percent is distributed among 15 base-metal mines and as a byproduct of 5 gold-silver mines. The Oroya plant is the sole producer of blister copper, and early in 1942 it initiated production of electrolytic copper on a small scale. Production in all forms has declined from the peak of 43,965 metric tons in 1940 to 32,390 tons in 1944.

Gold.—About two-thirds of the gold produced in Peru comes from gold-silver mines and one-third from complex-ore mines in association with base metals. Considerable interest is being shown in gold mining, and several new mines have been developed during the year, notably in and near the coastal region. The sale of gold is unrestricted in Peru, and appreciable quantities of gold obtained from placers in the southeastern montaña are believed to be unreported in official production statistics, which show a steady decline from 285,189 ounces in 1941 to 175,180 ounces in 1944.

Lead.—At 52,501 metric tons, the 1944 production of lead exceeded that of any previous year in Peru's history and represented an increase

of 10 percent over that of 1943. Cía. des Mines de Huaron, Cía. Minera Atacocha, S. A., and Cerro de Pasco Copper Corp. were the chief producers. The three companies combined mined half the Peruvian output in 1944, the other half coming from 15 complex-ore mines and 5 gold-silver mines. All of the refined lead is produced by the Oroya plant.

Mercury.—Interest in mercury mining revived in 1941, and some production was reported in 1942, though not quantitatively, when a 20-ton Gould rotary furnace was installed at the Chonta mine. Production amounted to 326 flasks in 1943 and 152 flasks in 1944. Progress on the construction of a 250-ton mercury reduction plant at the old and formerly very important Santa Barbara mine is proceeding slowly, and completion in 1945 is doubtful.

Molybdenum.—Peru Molibdeno, S. A., which in recent years has supplied almost the entire output of molybdenum concentrates, closed its concentrator in October 1944 because of approaching exhaustion of developed ore reserves and financial difficulties. Subsequently it renewed operations for about 3 months, until its contract with United States Commercial Company was canceled. The only other producer, the Salazar mine, is too small to be of consequence, and Peru's 1945 production of molybdenum is expected to register an abrupt drop. Production on a metal-content basis declined from 166 tons in 1940 to 62 tons in 1944.

Silver.—About 85 percent of the silver produced in Peru is recovered as a byproduct in the treatment of copper, lead, and zinc ores and 15 percent from gold-silver ores. Half of the 15,832,440 troy ounces produced in 1944 came from 5 leading companies and the balance from 20 complex ore mines and 14 gold-silver mines. In the production of silver, Peru ranks second only to Mexico in Latin America and fourth in the entire world.

Tin.—Less than 100 tons of tin are refined annually at Oroya as a byproduct of ores from Cerro de Pasco. No production has been reported, however, for 1944.

Tungsten.—The modest output of 583 metric tons of 60-percent WO_3 concentrate equivalent in 1944 was mostly from the Málaga mines, with the Cahuide mine the only other producer reported.

Vanadium.—Since 1941, when the United States displaced Peru as the world's foremost producer of vanadium, Peru has continued in second place. All production in 1944 was from the Minaragra mine of the Vanadium Corp. of America, where construction of a leaching plant of 200-ton daily capacity was completed during the latter part of the year. The decline in production from 1,150 tons in 1940 to 518 tons in 1944 is largely attributable to the gradual exhaustion of direct-shipping oxide ores.

Zinc.—Preliminary reports indicate that the most important mineral development of the year was a 79-percent increase over 1943 in the mine production of zinc, which is stated to have exceeded 56,000 metric tons of contained metal. Eighty percent of this amount was mined by the leading 4 of 11 producing companies: Cerro de Pasco Copper Corp.; Cía. Minera Atacocha, S. A.; Volcan Mines Co.; and Cía. des Mines de Huaron. Production of refined bars by the electrolytic zinc pilot plant at Cerro de Pasco has been reported as 1,225 tons in 1943 and 1,441 tons in 1944.

Nonmetallic minerals.—The production of cement by two plants established a new all-time high of 248,537 tons in 1944. Production of calcined gypsum, although relatively unimportant, also reached an all-time high in 1944, with 25,190 metric tons, the output of 5 small plants. Sulfur production is solely from Azufrera Panarany in the Department of Tacna. Salt is produced from salinas, wells, and mines at 32 localities in 16 Departments. Mineral waters are sold from 4 towns. Manganese sulfate is obtained as a byproduct of the lixiviation of copper-silver ores by the Lampa Mining Co.

Coal.—Coal-production figures for 1944 have not been received. During the year the Banco Minero del Peru ventured into the mineral-exploitation field for the first time, starting development of the bituminous coal deposits at Oyon, Department of Junin. Sales are to Lima and other urban centers, but the bank also plans to produce coke for the export trade. Of the total country output of 186,996 metric tons in 1943 that of Goyllarisquiza comprised 93 percent, most of which was consumed by the Oroya smelter and the Cerro de Pasco Railroad. Of the five anthracite mines operating in 1943, the Mis Suenos mine at La Galada, the Jose Balta mine at Los Banos, and the Lord mine at Bambas produced 98 percent of the total output. In the La Galada region plans were under way in 1944 to install washing plants to improve the product for sale in export.

Petroleum.—Production of 14,390,961 barrels of crude petroleum in 1944 represented a decrease of only 2 percent from that of 1943 but was about 3 million barrels, or 18 percent, short of the peak year 1936. International Petroleum Co., Cía. Petrólera Lobitos, Petróleo del Estado (Zorritos), and Cía. Petrólera Ganso Azul are the four companies operating in Peru; about 82 percent of production came from International Petroleum Co. and 17 percent from Cía. Petrólera Lobitos, based on 1943 figures. The producing fields are La Brea and Parinas near Talara, Lobitos and El Alto near Cabo Blanco, Zorritos, and Ganso Azul at Agua Caliente. International Petroleum Co. and Cía. Petrólera Lobitos also produced 1,035,219 barrels of natural gasoline in 1944, in proportions of about 90 and 10 percent, respectively. Most of the crude petroleum produced in the country is processed at the refinery of the International Petroleum Co. at Talara. Between 300 and 400 thousand barrels go to the State refinery at Villar, and between 200 and 300 thousand barrels are exported.

Exports.—The United States continued to be Peru's best customer in 1944, receiving (on the basis of preliminary unofficial figures) all of the copper, zinc concentrates, gold, tungsten, vanadium, molybdenum, cadmium, and mica and most of the silver, lead, antimony, and mercury that was exported. The United States was also the largest single recipient of white arsenic, but more than half of that exported was destined to Brazil, Uruguay, Colombia, Chile, and Venezuela. England took the largest part of the manganese sulfate, and neighboring countries in South America received most of the other nonmetallic minerals exported.

SURINAM

Netherlands Guiana

Bauxite.—Surinam is the United States chief source of imported bauxite. Shipments in 1944 were divided between 517,707 metric

tons by Surinamsche Bauxite and 108,097 tons by N. V. Billiton, and the end of the year found large port stocks awaiting allocation of ships by the War Shipping Administration. The all-time peak in exports was reached in 1943 with 1,655,147 tons, and the 62-percent drop in 1944 is attributable to relaxation of military demands and increased utilization of heavily accumulated stocks in the United States.

In December 1944 the Construction Aggregates Corp. of Chicago completed dredging started in June 1943, providing a ship channel $9\frac{1}{2}$ miles long and through a bar at the mouth of the Surinam River that will permit full loading of ships at the river ports.

Gold.—Gold in Surinam is recovered from placer deposits by the use of long toms and sluices and by hand panning. During the war years various defense projects undertaken by the local government are held responsible for diverting many of the independent miners away from their usual activities, with the consequent decline in gold production from the 15,921-ounce output of 1940. Independent operators supplied only 1,323 of the total 5,723 troy ounces produced in 1944. The remaining 4,400 ounces were the product of the only two organized companies in the colony, the Sara Creek Mining Co. and White Water Mines, Ltd.

URUGUAY

Gold.—The only metal mining in Uruguay is for gold in quantities too small to be reported since the 1,364-ounce output of two mines in the Rivera district in 1941.

Nonmetallic minerals.—More important to Uruguay are the deposits of nonmetallic minerals, particularly in the field of construction materials. Reports of production are spotty and incomplete; but talc and mica are quarried and ground locally, and building stone, crushed stone, and sand in surplus of domestic needs figure largely in the export trade with neighboring countries. Two plants at Montevideo and Nueva Carrara produce about 180,000 metric tons of cement annually, using domestic raw materials and imported fuel.

VENEZUELA

Gold.—Gold is the only metal currently mined in Venezuela. Lode mining has been confined to a region in the State of Bolívar about 100 miles southeast of the port of San Felix on the Orinoco River and 12 miles from the town of Guasipati. New Goldfields of Venezuela is the most important of three companies that have continued operations through 1944. Production has declined steadily from 146,792 troy ounces in 1940 to 77,716 ounces in 1944 but may be expected to improve with the removal of restrictions imposed by wartime necessity. Gold continues to be washed from placer deposits in the Caroni region near the head of the Yuruari River and its tributaries. The extent of these deposits has never been determined, but in general they are not believed to be individually large enough for dredging operations.

Iron.—In 1939 the Iron Mines Co. of Venezuela, a subsidiary of the Bethlehem Steel Co., obtained concessions centering in El Pao 30 miles south of the town of San Felix. Ore reserves estimated at 60 to 100 million tons of hematite are reported to contain 68 percent

iron and very small amounts of phosphorus, sulfur, and silver. The company has started construction of a mine plant and transport facilities for the daily export of 6,000 tons of ore and hopes to be ready to ship before the end of 1945. The chief obstacle to be overcome is the dredging of a deep channel through the Boca Grande and Yua sand bars at the mouth of the Orinoco, to permit fully loaded ocean freighters to pass down river to the sea.

Nickel.—The International Nickel Co. is showing active interest in a deposit of garnierite at Lorno de Hierro near San Pedros, south of Caracas. Lorno de Hierro is estimated to contain millions of tons of ore averaging more than 2 percent nickel but of a grade possibly too low to be handled by present metallurgical processes.

Vanadium.—Venezuela has never deliberately undertaken or reported the production of vanadium. Nevertheless, the metal in the form of vanadium pentoxide is regularly recovered from flue dust from the stacks and boilers of ships burning Venezuelan fuel oil. Several tons of flue dust are bagged and sold annually by tanker and other ship lines in American ports. The material as marketed contains 12 to 15 percent V_2O_5 .

Asbestos.—The mining of Chrysotile asbestos is being undertaken west of Tinaquillo, State of Cojedes, where Cía. Anónima Minas de Amianto de Tinaquillo has completed a mill with a monthly capacity of 25,000 tons rock intake and 500 tons fiber output. Small tonnages have been produced for several years, and mill operations started during the first half of 1945. Annual production of 6,000 tons of fiber is anticipated.

Diamonds.—Venezuela has two main diamond-producing areas in the State of Bolívar, one including the lower Caroni River and tributaries and the other the Gran Savana at the southeastern tip of the country. The Caroni district usually supplies about one-fourth and the Gran Savana three-fourths of the total diamond output of the country. Venezuelan diamond production first became commercially important in 1937, reached a peak of 34,048 carats in 1942, and dropped to between 22,000 and 23,000 carats in 1943 and 1944. The rise in output was the result of the war demand for industrial stones and consequent high prices. The post-1942 decline is attributable to deplorable working and living conditions in the areas (including shortages and high cost of food), lack of transportation, and the drop in world prices accompanied by cessation of the United States Foreign Economic Administration's diamond-buying program in Venezuela. A favorable future is dependent on possible highway construction to open up the areas, large investments of capital, and revision of Government regulations to permit large-scale mining with mechanical equipment.

Other nonmetallic minerals.—Magnesite is mined at Lomo de Guerra on Margarita Island by Industria Nueva Esparta, C. A. The company produced only 700 tons of crude in 1944, for consumption in its magnesite-products factory in Caracas. Cement and marine salt are also produced for domestic use only.

Coal.—Two coal mines are operated in Venezuela, one near Altigracia in the State of Guárico and the other at Naricual near Barce-

lona. The coal is subbituminous, production is less than 12,000 tons a year, the condition of the mines is poor, operations are hampered by inadequate transportation facilities, and British brick coal or patent fuel from Cardiff can be bought in Caracas cheaper than Venezuelan coal.

Petroleum.—Venezuela is the largest producer of crude petroleum in Latin America and the third largest in the world, exceeded only by the United States and the Soviet Union, and 1944 established a record year in the history of Venezuelan production with an output of 257,045,668 barrels. In western Venezuela 10 fields in the State of Zulia and 3 in the State of Falcon supplied 71.3 percent of the total production, while the remaining 28.7 percent came from eastern Venezuela, with 12 fields in the State of Anzoategui, 6 in Monagas, and 1 in Guarico. On the basis of operating companies, 95 percent of the total was the output of the three leading producers: Creole Petroleum Corp., Mene Grande Oil Co., C. A., and the Shell Oil Co. subsidiaries. The remaining 5 percent was distributed among Cia. Consolidada, the Socony-Vacuum Oil Co., British Controlled Oilfields, Ltd., two subsidiaries of The Texas Oil Co., and the Orinoco Oil Co. The trend continues upward, and production in 1945 is expected to surpass that of 1944.

Seven hundred miles of pipe line in eastern and 160 miles in western Venezuela carry crude petroleum to shipping points on the Orinoco River, the Caribbean Sea, and the Lake Maracaibo area.

Exports.—In 1944 Venezuelan exports of petroleum (90 percent in the form of crude) surpassed all previous records and as usual dominated the export field, representing between 85 and 90 percent of all exports in point of value. Quantities and destinations are presented in the following table.:

Venezuelan exports of petroleum in 1944

[In barrels of 42 gallons]

Country of destination:	Crude petroleum	Refinery products
Aruba.....	101, 596, 980	2, 956, 854
Curaçao.....	76, 128, 153	9, 187, 734
United States.....	45, 258, 928	1, 147, 956
Canada.....	3, 758, 237	386, 074
British Antilles.....	1, 255, 553	1, 205, 504
Canary Islands.....	641, 630	-----
Uruguay.....	413, 718	966, 131
Brazil.....	65, 385	2, 411, 227
Portugal.....	55, 295	-----
Argentina.....	-----	577, 560
Panama.....	-----	128, 643
Fuel to tankers.....	-----	1, 442, 819
Total.....	229, 173, 879	20, 410, 502

Value of mineral exports other than petroleum decreased 14 percent in 1944 from that of the preceding year. Principal items were gold and diamonds.

AFRICA

By FRANK L. FISHER

The review of the African mineral industry for 1944 shows the results of the general continental program to provide raw materials for the Allied war machine. The disruption of their national economy left a definite pattern in the mineral-producing countries, marked by varied inflation, scarcities of imported manufactured goods, an acute shortage of shipping space for civilian supply, labor migration, and shortages affecting the mineral production in some areas, and a general decline in gold production but pronounced increases in production of the metals necessary to the war effort. A trend toward United States manufactured products was evident in 1944 with the increased realization that the United States is the market for African raw materials, at least until European resettlement is complete.

During 1944 the British and Belgian colonies continued aggressive development of their mineral resources, whereas the French, Portuguese, and Italian colonies were relatively inactive in their efforts to promote exploitation of their deposits. The few countries that do not have colonial domination are in regions of unfavorable mineralization.

The mineral industries of Algeria, Angola, Bechuanaland, British East Africa (Kenya, Uganda, and Tanganyika), Egypt, French Cameroons, French Morocco, Madagascar, Mozambique, Tunisia, and South-West Africa were of secondary importance in 1944. No new developments of importance occurred in the mineral industries in the following countries during 1944, nor is their mineral industry of any significance except for some primitive mining of salt and gold: Anglo-Egyptian Sudan, British Somaliland, Cabinda, Eritrea, Ethiopia, French Equatorial Africa (except Cameroons), French West Africa, French Somaliland, Gambia, Italian Somaliland, Liberia, Libya, Rio de Oro, Rio Muni, and Spanish Guinea.

UNION OF SOUTH AFRICA

The Union of South Africa was the major African mineral producer in value in 1944. Gold, diamonds, and coal dominated the production, and exportable surpluses of copper, tin, asbestos, silver, platinum metals, manganese, and chromite were recorded. The search for strategic metals for Allied interests resulted in the accelerated production of beryl, corundum, ochers, mica, optical calcite, nickel, natural graphite, and tungsten, and domestic demand spurred production of titaniferous iron ore, pyrites, antimony, barite, gypsum, fluorspar, mercury, and salt.

The Witwatersrand gold-mining industry, on which the economy of the Union depends, operated on a reasonably stable basis during the year. The general economic strain of war throughout the continent, labor migration, and an abnormal rainfall that flooded several mines contributed to the decline in production. One company discontinued operations during the year, and the Van Ryn Deep, Witwatersrand Deep, Langlaate Estate, and New Modderfontein

Deep mines served notice of their plans to suspend operations in 1945.

The 1944 gold production again led the world with 12,277,228 fine ounces—522,793 less than in 1943.

Optimism prevailed in the gold region with the anticipated development of two new gold fields—the Far West Rand area and the Orange Free State field. Sixteen new gold mines are planned for these fields, involving a capital expenditure of approximately \$320,000,000 in the postwar era. The Orange Free State field, surveyed by a large-scale and well-planned drilling program by various companies since 1937, is 90 miles north-south and 30 miles east-west, with its center at Odendaalrust. Exploitation of both fields will necessitate deep-shaft operations.

Diamond sales of approximately \$70,000,000 in 1944 were less than the 1943 record year. Production, third largest in the world, amounted to 933,682 carats. Coal production continued to increase to 22,590,201 metric tons in 1944. Exports of cargo and bunker coal totaled 3,995,740 metric tons. The Union held its place as third largest producer of platinum and allied metals, with approximately 80,000 ounces for the year.

The bulk of the diamonds, asbestos, and copper was exported to the United Kingdom. The United States and the United Kingdom were the chief importers of the chromite, manganese ore, beryllium ore, fluorspar, mica, and corundum produced in the Union. The coal was exported to countries on the east and west coasts of the continent, the Middle East, Ceylon, Argentina, and Brazil.

BELGIAN CONGO

The Belgian Government need for revenue coupled with the war demand to keep the Belgian Congo mineral production at an accelerated rate during 1944, and the country maintained its position as the world's principal source of industrial diamonds, radium-uranium, and cobalt. Production of copper, gold, silver, tin, tungsten, zinc, tantalite-columbite, cadmium, and manganese was maintained at capacity. Exploration for mineral deposits in the colony has been extensive and thorough, but the possibility of the discovery of new, large deposits is still considered favorably.

Production of diamonds has been estimated at 7,540,000 carats in 1944, a decline from the peak of 9,600,000 carats in 1940. Forminière (Soc. Internationale Forestière et Minière du Congo) is in control of and manages all diamond-mining operations; most of the diamonds come from the Beceka field. Estimates of diamond reserves indicate a potential annual production of 7,000,000 carats of Beceka crushing bort for 14 years and 500,000 carats of cuttable stones for 12 years, with the possibility of an additional 10 years' production of both at the same rate. The Congo continued to supply about 60 percent of the world's cobalt with a production in 1944 of 2,200 tons obtained as a byproduct of the copper production. Operations were resumed at the Shinkolobwe radium-uranium mine in 1944. This mine had been shut down since 1937, the trade being supplied from available stocks since that time.

Trade with the United States has increased from 7.6 percent (\$2,500,000) of the total imports in 1938 to 41.35 percent (\$21,638,000) in 1943. The export trade of Belgian Congo directly to the United

States was approximately \$11,000,000 in 1943. Favorable continuation of this trade in the postwar period is likely, and the United States will be in position to participate to a greater extent than in the past in the further economic development of Belgian Congo.⁹

The bulk of the industrial diamonds and tin are exported to the United States. The copper is refined in the United States and re-exported to the United Kingdom.

NORTHERN AND SOUTHERN RHODESIA

The copper belt of Northern Rhodesia was the British Empire's largest copper producer, with more than 200,000 tons during 1944, and the same region was second to Belgian Congo as a producer of cobalt. The N'kana mine continued to be the major operator and produced substantial quantities of selenium, gold, and silver in addition to the cobalt and copper. The Broken Hill mine contributed important quantities of zinc, vanadium, and lead during the year. Northern Rhodesia also produced minor amounts of mica, bismuth, tin, manganese, and iron ore.

A slight decrease in gold output was noted for Southern Rhodesia during 1944, but the country continued to maintain a production of more than 500,000 ounces of gold and 100,000 ounces of silver. Chromite production exceeded 300,000 tons during the year. The country was the second-largest producer of asbestos, but production statistics for 1944 are not available. Minor production of tin, tungsten, and mica was recorded during the year.

BRITISH WEST AFRICA

Nigeria.—Tin and columbite comprised most of the mineral production in Nigeria in 1944. Tin output was maintained at approximately 1,400 tons of cassiterite per month, and columbite production approached a 200-ton per month average. Efforts to develop the wolframite deposits were not as successful as expected, and production was negligible. About 300,000 tons of coal for domestic consumption were mined during the year. Gold production, mainly by primitive mining methods, was normal. The columbite is exported to the United States and the cassiterite to the United Kingdom.

Gold Coast.—Gold Coast was a major African mineral producer during 1944, with 534,487 fine ounces of gold, 512,528 dry metric tons of manganese ore, 1,167,858 carats of diamonds, and 108,939 metric tons of bauxite. Output of these minerals showed a general decrease from 1943. The colony also produced 56,820 fine ounces of silver and relatively small quantities of iron ore, tin ore, and platinum.

Sierra Leone.—The production of diamonds is the major mineral industry of this country. Output in 1944 was approximately 900,000 carats. The colony also produces gold, silver, platinum, and chromite, but in general the mineral deposits of the colony have not been developed on a large scale.

OTHER COUNTRIES

Algeria.—The Algeria mineral industry was retarded considerably in 1944 as a result of the war. Only iron and phosphate rock were

⁹ A foreign minerals survey on the Mineral Resources of the Belgian Congo is in preparation and is expected to be published during 1945.

produced in exportable quantities. Pyrites and an increased quantity of coal were mined for local consumption, but the production of lead, zinc, and antimony was at a standstill.

Angola.—Production of industrial diamonds in Angola was normal during 1944 with about 786,000 carats. An extensive campaign to secure strategic minerals resulted in a production of 3,860 kilograms of mica and 1,000 kilograms of quartz crystal. Interest was revived in the extensive asphalt deposits, and 4,363 metric tons of rock containing 22 percent asphalt were mined. Gold, sea salt, copper ore, and manganese ore were produced in relatively small quantities.

Bechuanaland.—A small production of gold and silver continued to be the only minerals of economic importance extracted in Bechuanaland during 1944.

British East Africa.—Gold and silver remained the most important minerals produced in Kenya Colony in 1944. Production of asbestos, graphite, lime, mica, quartz crystal, salt, soda, and talc was also recorded. Gold, silver, and industrial diamonds were the significant minerals produced in Tanganyika during 1944, with minor quantities of corundum, mica, salt, and tin. Uganda Protectorate supplied minor quantities of bismuth, gold, mica, tantalite, columbite, tin, tungsten, and beryl in 1944.

Egypt.—The 1944 mineral production in Egypt was confined primarily to nonmetallic minerals, particularly building materials. War conditions temporarily caused a gradual decrease in the production of these products.

French Cameroons.—Tin, gold, and rutile continued to be mined in French Cameroons in increased quantities.

French Morocco.—Phosphate rock remained the most important mineral produced in French Morocco during 1944; output was nearly 1,500,000 metric tons. The country also contributed an important production of cobalt, antimony, lead, asbestos, and gold.

Madagascar.—The principal minerals produced in Madagascar in 1944 were graphite, mica, and corundum in increased amounts. Graphite production was 14,478 metric tons (11,207 flake, 3,271 fines) compared with 12,949 metric tons in 1943. Mica production rose from 343 metric tons in 1943 to 493 in 1944. An expanded demand for corundum by the United States resulted in an increase from 14 metric tons in 1943 to 70 metric tons in 1944. This French colony also had a minor output of gold, coal, beryllium, lead, bismuth, talc, kaolin, and feldspar.

Mozambique.—The significant developments in Mozambique in 1944 were the increased production of corundum, the progress made toward completing the Beira-Tete railroad, which will facilitate transportation from the Moatize coal field, and the granting of an oil concession to Manica Trust, Ltd., of Beira for the most exhaustive oil exploration carried on in the colony to date.

Tunisia.—The return to normal in the mineral industry continued to progress satisfactorily in Tunisia during 1944. Iron-ore output, which had averaged 480,000 tons during the past 19 years, reached 100,000 tons in 1944. Lead attained one-third the normal production rate, and approximately 500,000 tons of phosphate rock were produced during the year. Minor production of zinc, mercury, and coal was also resumed.

South-West Africa.—This country was important in the output of vanadium ore and lepidolite during 1944 and produced over 154,000 carats of industrial diamonds and significant quantities of graphite. It also reported production of beryl, gold, salt, tin, and tungsten.

EUROPE

By BYRON B. McCROSKEY

Throughout 1944 the European mineral industries were confronted with the prodigious task of supplying vast quantities of minerals and mineral products necessary to prosecution of the war. As the year progressed the increased tempo of the fighting greatly accelerated the military requirements of both the United Nations and Germany for these materials.

German economy during the entire year was in a constant state of rapid deterioration that accompanied loss of territory and incessant bombing. The lack of adequate quantities of petroleum and petroleum products was perhaps the most important single factor contributing to the final German collapse. By the end of 1944 approximately two-thirds of its crude-oil resources had been lost. In addition, a large part of its synthetic-oil capacity had been destroyed by bombing. After occupation of the Rumanian and Polish oil fields by the Russians during 1944, German crude-oil supplies were completely dependent on the recently developed fields of Austria, Hungary, and Germany proper. Total production from these sources was estimated at approximately 27,000,000 barrels for the year, or equivalent to about 1.6 percent of the United States 1944 crude-oil production.

As before the war, Hungary continued to be one of Germany's principal sources of bauxite.

Although statistics are not available, it is logical to assume that the Austrian iron and steel industry became vital to Germany, especially after the liberation of France and Belgium and the highly destructive bombing of the Ruhr district.

By the end of 1944 Germany had been forced to evacuate most of the Balkan Peninsula, virtually all of France and Belgium, and the southern part of Italy. The Balkan withdrawal lost for Germany the rich mining areas of Yugoslavia, which were believed to have furnished for a time approximately half of the German new supply of chrome ore, two-fifths of the copper and antimony, and one-third of the lead.

The invasion of France by the United Nations not only deprived Germany of the highly important iron, steel, and light metals industries of France but also severed trade connections with Spain and Portugal which had previously been of strategic importance to Germany as a source of mercury, tungsten, and tin. The loss of this trade was a severe blow to the mineral economy of both countries. Portuguese tungsten and tin production dropped to a fraction of the 1943 output and was brought to a standstill before the end of the year. In Spain the loss of German trade immediately ended the production boom in many of the mineral and mineral products previously shipped

to Germany. Tungsten and mercury were the most noticeably affected, iron ore and lead to a less extent.

Northern Italy, most of the Netherlands, and all of Denmark and Norway remained zones of German occupation throughout the year. Of these countries only Italy and Norway were of significant importance to Germany as sources of mineral supplies. Before invasion by the United Nations Italy was important to Germany as a producer of aluminum, mercury, pyrites, lead, zinc, and sulfur. By the end of the year, however, the principal mercury, pyrite, lead, zinc, and sulfur mines were in the hands of the forces of the United Nations.

Norway's importance as a mineral producer decreased considerably during the year. Estimated aluminum production was 15,000 tons for the year, compared with 27,000 tons for 1943. Although the production of other minerals and mineral products for the first 9 months of 1944 compared favorably with that of the corresponding period of the preceding year, in most instances it was substantially lower than during the prewar period.

Although the Germans throughout the year were trying to obtain from their rapidly diminishing resources sufficient military supplies to continue the war, the United Nations were confronted not only with the problem of greatly increasing their military supplies but also that of restoring the economy of France and adjacent liberated areas of Belgium, Luxembourg, and the Netherlands to a condition that would at least satisfy the minimum civilian requirements. Unfortunately, liberation of these areas was accompanied by a most severe coal shortage. As the economy of these countries depends almost completely on coal, the urgency of immediately obtaining adequate coal supplies, either by increased production or imports, became paramount.

The coal mines of these countries were recovered more or less intact, but owing to the shortage of labor, equipment, and transportation facilities production by the end of 1944 was about only one-half of the normal output. British coal production during 1944 was the lowest for a normal working year since 1892, and the amount available for export was reduced to such an extent that it was impossible for France to obtain quantities of coal, coke, and briquets anywhere near the 5 to 9 million tons per year imported from Great Britain before the war.

During 1944 Russian economy to a large extent was dominated by the tremendous task of rehabilitating that portion of its mining and metallurgical industries situated in the liberated areas. Restoration of the coal mines of the Donets Basin, which before the German invasion supplied more than 50 percent of the country's total coal output, was of major importance. These mines, liberated during 1943, were estimated to be producing by the end of 1944 at the rate of approximately 25,000,000 tons of coal annually—about 30 percent of their prewar capacity. The estimated 30-percent increase in total 1944 coal production over that of 1943 was due largely to the renewal of mining operations in this basin. In addition to the rehabilitating of former producers, numerous new collieries were opened, and several new discoveries were made during the year.

The restoration of the Krivoi Rog iron and the Nikopol manganese mines was started immediately after their liberation in April and May 1944. Although rapid progress was made, the damage to the Krivoi Rog mines was so severe it was estimated that a minimum of

2 years would be required to restore them to normal. Before the war the Krivoi Rog district supplied approximately 62 percent of the country's total iron-ore production. Rapid progress was made also during the year in restoring the Ukraine iron and steel industry to its former productivity.

In a statement made in late June 1944, it was revealed that Russia's annual output of steel was about 12,000,000 tons, that the prewar level had reached 22,500,000 tons, and that future plans were to increase annual production—presumably in two 5-year periods—to 60,000,000 tons.

The vast rehabilitation program in progress during the year was accompanied by expansion of mineral production in areas outside of the devastated zones, opening of new mines and plants, and discovery of new mineral deposits. The growth of the eastern iron and steel industry continued. Coke production was estimated at 11,000,000 tons, of which about 10 percent came from the devastated areas. Oil production was estimated at 275,000,000 barrels for the year—about 27 percent over the 1943 output. Increased production of fluorspar, mercury, aluminum, molybdenum, and other metals and minerals was anticipated, and the press reported new discoveries of molybdenum, mercury, tungsten, and other minerals during the year.

THE MIDDLE EAST ¹⁰

By BYRON B. McCROSKEY

The petroleum industry of 1944 was highlighted by the amazing disclosures made concerning the oil fields of the Middle East, or more specifically the Persian Gulf area. Developments in the area were so outstanding that they attracted the attention not only of the petroleum industry but of the entire world. Perhaps the most important investigation made of the area was that of the Technical Oil Mission to the Middle East, which in its preliminary report,¹¹ published in the early part of the year, revealed proved and indicated oil reserves of 25 to 27 billion barrels for the six countries—Iran, Iraq, Saudi Arabia, Kuwait, Bahrein Island, and Qatar—bordering the Persian Gulf. These tremendous reserves, equivalent to about one and one-fourth times the proved reserves of the United States or about 38 percent of those of the entire world, were the result of an extremely limited amount of exploration work—approximately 150 wildcat wells or less than 5 percent of the number of wildcat wells drilled in the United States every year.

Although the production of the Persian Gulf fields reached about 150 million barrels during 1944, or 34 percent more than in 1938, this increase in no way was proportional to the increased potential value of the region. The refinery capacity of the area was also enlarged during the year to about 500,000 barrels per day. Compared with the 1,677,753,000 barrels of crude oil produced in the United States during 1944, the output of the Persian Gulf fields appears insignificant. However, preliminary plans are to increase the production of the area

¹⁰ Includes Turkey, Syria, Palestine, Trans-Jordan, Iraq, Iran, Afghanistan, and all the countries of the Arabian Peninsula.

¹¹ De Golyer, E., Preliminary Report of the Technical Oil Mission to the Middle East: Bull. Am. Assoc. Petrol. Geol., vol. 28, No. 7, Tulsa, July 1944, pp. 919-923.

to a million barrels per day as soon as transportation facilities are available and markets can be developed in Europe and Asia.

THE FAR EAST AND PACIFIC AREAS

By NELSON DICKERMAN

In 1944 mineral production in the Far East, Australia, and the Pacific islands followed much the same pattern as in 1943. Australia, China, India, and New Caledonia continued to supply the United Nations with vital metals and minerals. Burma, Thailand, French Indochina, the Netherlands East Indies, the Philippines, and Christmas, Palau, Ocean, Nauru, and Hainan Islands remained under Japanese domination, but the Japanese lost control of the shipping lanes from these conquered lands and at the end of the year were able to bring very little of the coveted ores, minerals, and oil to the home islands. Allied armies moved into Burma, the Philippines, and later Borneo and tightened the blockade of Japanese shipping by air, submarine, and naval task forces. While Japan looked to the south for iron, manganese, chrome and nickel ore, bauxite, and tungsten, the United Nations looked to the same areas for tin and rubber which are badly needed. Even after liberation it will be a long time before these areas will be able to supply much rubber and tin.

INDIA

Indian mineral production in 1944 showed a decrease in most lines from that of 1943, due principally to inability of the railroads to handle the heavy traffic, to the congestion of the ports moving military supplies, and to a certain extent to a scarcity of labor in the mining fields. At the beginning of 1944 some 700,000 metric tons of manganese ore were in stock piles, and production was only nominal—about 10,000 to 12,000 tons a month. Imports of Indian manganese ore into the United States were less than 43 percent of the amount received in 1943. Iron and steel production was down except for finished steel products, which were up some 12,000 tons. Coal output increased about 2 percent, but not sufficiently to meet all demands. Petroleum was up about 13 percent. Exports of mica were down more than 30 percent, but ilmenite exports to the United States increased about nine times. The United States also received beryl, futile, and zirconium from India during the year.

BURMA

The Japanese were not able to get much lead or zinc in 1944 from the Bawdwin mine of the Burma Corporation but did obtain enough oil from the Yenangyuang and Chauk oil fields to meet their local needs. As the Bawdwin mine was liberated in the early months of 1945 the British should be able to rehabilitate the mine workings and produce some badly needed lead and zinc in the early part of 1946. Before the war Bawdwin produced some 80,000 tons of lead and 60,000 tons of zinc a year. The oil fields which have now been occupied and which normally produced almost 8 million barrels per year, should be put in commission within 6 to 9 months after oil-well supplies and refinery equipment are provided. This should relieve the burden to some extent on the Persian Gulf tankers.

FREE CHINA

In Free China in 1944 mineral production was disappointing and showed a marked decrease from production in 1943, except for petroleum products and steel, which increased substantially. The decrease was attributed to the loss of territory, especially in Hunan and Kwangsi Provinces, and to inflation which caused much hardship to producers.

The following table presents 1944 production and the percentage change from 1943.

Mineral production of Free China in 1944¹

Mineral:		Production, 1944	Change from 1943, percent
Coal	metric tons	5, 457, 756	-9
Coke	do	260, 026	-31
Copper (refined)	do	185	-76
Lead (refined)	do	646	-45
Zinc (refined)	do	331	-41
Tungsten	do	3, 235	-64
Antimony (pure)	do	203	-52
Tin (refined)	do	2, 195	-50
Mercury	do	103	-13
Pig iron	do	40, 134	-52
Steel	do	14, 391	+97
Crude oil	42-gal. bbl.	504, 701	+13
Gasoline	do	96, 332	+33
Kerosine	do	51, 444	+287
Diesel oil	do	3, 699	+206

¹ Source: Report of U. S. Foreign Service officer, Chungking.

A forecast of improved production in 1945 is based largely on the recommendations of the Nelson Mission to China and on the mission's action in setting up a Chinese War Production Board in November 1944 and providing the assistance of technical specialists. Dr. Wong Wen-Hao, Chairman of the War Production Board and Minister of Economic Affairs, on May 2, 1945, stated that there was a distinct increase in output of 18 kinds of vital metals and industrial products of practical importance in March 1945 over November 1944.

BRITISH MALAYA

Very little information has come out of British Malaya as to activities in tin and rubber production. It is unlikely that the Japanese have pushed either of these industries, as they had plentiful supplies of both and would only encourage production to keep the native population employed.

The British Government is now considering rehabilitation of the tin industry in the shortest possible time after the peninsula is freed. It is unlikely that much tin will be recovered by dredging before the end of 1946 at the earliest, although by providing gravel pumps and Diesel engines for power some may possibly be forthcoming from Malaya not later than 6 months after its liberation. This, with the Chinese workings and a certain amount of tin which has probably been secreted by the Chinese, should help relieve the scarcity of that metal.

JAPAN

In 1944 Japanese mineral production continued at a high rate. The movement of raw materials and goods from Manchuria, Korea, and North China was handicapped by the shortage of shipping created by the sinking of ships by Allied submarines. This was overcome in part by the transfer of more cargo to the railroads on the mainland and the short shiphaul from Korea and Manchuria through the Sea of Japan. The movement of supplies from Malaya, Netherlands East Indies, Thailand, French Indochina, the Philippines, and Formosa became steadily more difficult as the American forces moved westward and especially after landings in the Philippines. This western movement gave the submarines forward bases for their operations, thus increasing their striking power, and also advanced air bases from which planes could take a heavy toll of all Japanese shipping moving north. By the end of 1944 the amount of raw material and oil moving to Japan from the south was only a small fraction of that shipped in 1943. This was not immediately serious for the Japanese war industries as ample supplies had been stored, but it was a warning of what the future offered.

In 1945 Allied forces some 325 miles south of Kyushu and only 400 miles from the Chinese coast cut all direct shipping from the south Pacific, Formosa, North China, Korea, and the southern ports of Manchuria, and reduced the Japanese to total dependence on their stock piles. As bombs continued to destroy the large industrial plants and interrupted rail and road lines, it is possible that for lack of materials some plants may have had to close while supplies were in abundance at other points in the islands. This disruption of supply lines and production facilities led to the collapse of Japan in August.

NETHERLANDS EAST INDIES

Little is known of mineral production in the Netherlands East Indies through 1944. Allied attacks on shipping and the bombing of oil installations and mines undoubtedly cut down supplies to Japan through the latter part of the year.

The Netherlands East Indies, through its Planning and Reconstruction Commission in New York, has set up a credit of 140,000,000 guilders to buy coal and tin-mining machinery, agricultural implements, fertilizers, and consumer goods in the United States. It has also asked quotations for tin dredges to be built in the United States and then towed across the Pacific to Banka and Billiton. The oil fields at Tarakan are now in operation as they are shallow and the fuel oil is of a quality that can be used directly without refining. To some extent this should relieve tanker service from the Western Continent. The oil fields around Brunei, Seria, and Miri in British Borneo are also shallow and undoubtedly will be quickly put back in service. This oil, too, is of a quality to be used directly from the wells with only simple refining.

AUSTRALIA

By F. M. CHACE

Production of metals and minerals essential to the war continued at a high rate in Australia during 1944. Notable increases took place in the production of metallic copper and slab zinc, and output of gold, lead, iron, and coal, although less than in 1943, was still well above prewar levels. Manpower shortages, inadequate supply of mining equipment and supplies, strikes, and other wartime difficulties prevented a higher rate of production.

Production of copper increased from a prewar level of less than 18,000 metric tons annually to approximately 31,300 metric tons in 1944. This increase was due almost entirely to the output of the Mount Isa mine in western Queensland, where lead-zinc mining was curtailed in 1943 so that all efforts could be concentrated on the copper ore body found in the hanging wall of the Black Star lead-zinc ore body.

Although mine production of zinc continued to decrease, the output of slab zinc increased from 77,600 metric tons in 1942 to 80,200 metric tons in 1944. Australian lead output has declined steadily from 274,400 metric tons in 1940 to 172,800 metric tons in 1944.

Owing to industrial disputes in the New South Wales coal fields, production of coal was relatively low in 1944. The recorded output for the Commonwealth dropped from 16,206,000 metric tons in 1942 to 13,958,000 tons in 1944. It was necessary to ration coal to both industrial and civilian consumers.

The Broken Hill Proprietary Co., Ltd., is developing large, high-grade hematite ore deposits on Yampi Sound. The total reserves of Yampi Sound are estimated at 187,000,000 tons to a depth of 500 feet below water level. Work is in progress at Wundowie, 41 miles from Perth, where the Western Australian Government is erecting a charcoal iron plant with a capacity of 10,000 tons a year, which if successful, calls for an increase to 100,000 tons of charcoal iron.

During 1944 and 1945 the Commonwealth and Tasmanian Governments are to spend £A3,000,000 (approximately \$9,750,000) to establish an aluminum-ingot industry in Tasmania, where cheap hydroelectric power is available. Bauxite is available in the Ouse Valley and elsewhere in Tasmania, with reserves totaling about 3,000,000 tons. The project is justified on the grounds of national defense.

The King Island scheelite mine between Tasmania and Victoria produced 190.9 metric tons of concentrates in 1943 containing 65 percent WO_3 . This is one of the largest scheelite deposits in the world, with a reserve of over 1,117,655 metric tons containing 0.70 percent WO_3 .

Tantalite produced at Wodgina and Greenbushes, Western Australia, and exported to the United States in 1944 contained 9,315 pounds of tantalum. The ore averaged 50 percent Ta_2O_5 . Mining of beach sands containing rutile, ilmenite, and zircon along the New South Wales-Queensland coast continued at an accelerated rate. Imports into the United States were: Ilmenite concentrates 158,605 pounds, rutile concentrates 3,516,000 pounds, zircon con-

centrates 43,400 pounds, and beryl 1,035,683 pounds containing approximately 10 percent BeO.

Gold production continued to decline. Western Australia dropped from 1,191,428 ounces in 1940 to 464,440 ounces in 1944; and output in Victoria from 180,567 ounces in 1940 to 56,512 ounces in 1944.

Water supply continues to be a serious problem to Australian mines. In the Broken Hill lead-zinc-silver district arrangements were made to bring in water by rail from the Darling River at Menindee. In March 1944 a 223-mile pipe line was completed from the Murray River on the Victoria-South Australia Border to Whyalla on the west coast of Spencer Gulf in South Australia. Whyalla is the center of a new and expanding steel industry, close to the major iron-ore fields at Iron Knob.

PHILIPPINE ISLANDS

With the Philippines liberated, the question of future American participation looms large. The Japanese did not work the gold mines but robbed them of much equipment, some of which was taken to the Lepanto copper mine at Mankayan in Mountain Province. By extensive development this mine, which produced some 7,500 tons in 1941, was thought to have furnished the Japanese with some 30,000 tons of copper a year. The Japanese also took stocks of manganese and chromite which were left at the mines but did not work these or the iron mines to any extent.

American holdings in the islands are large, but many of the buildings, plants, and mines have been destroyed or robbed by the invaders. To restore the islands to a postwar position of independence, in fact as well as politically, will require a large investment of capital and goods.

With the Philippines to receive their independence in 1946 and the Tydings Mission recommending a large grant of money to restore the islands' economy as well as extending the free entry of goods to both countries over a longer period than was set in the first Independence Act, the American position should have a great advantage over other nationals trying to enter that field.

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